R&S®VSE-K6
Pulse Measurement Application
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This manual applies to the R&S®VSE base software (1320.7500.02) version 1.10 and higher.
The following firmware options are described:

- R&S VSE-K6 (1320.7516.02)

This software makes use of several valuable open source software packages. For information, see the "Open Source Acknowledgement" on the software CD-ROM.
Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual: R&S®VSE is abbreviated as R&S VSE.

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1 Preface

1.1 About this Manual

This R&S VSE Pulse User Manual provides all the information **specific to the application**. All general software functions and settings common to all applications and operating modes are described in the R&S VSE Base Software User Manual.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the R&S VSE Pulse application**
  Introduction to and getting familiar with the application
- **Measurements and Result Displays**
  Details on supported measurements and their result types
- **Measurement Basics**
  Background information on basic terms and principles in the context of the measurement
- **Configuration + Analysis**
  A concise description of all functions and settings available to configure measurements and analyze results with their corresponding remote control command
- **Data Export**
  Description of general functions to export measurement data
- **How to Perform Measurements in the R&S VSE Pulse application**
  The basic procedure to perform each measurement and step-by-step instructions for more complex tasks or alternative methods
- **Optimizing and Troubleshooting the Measurement**
  Hints and tips on how to handle errors and optimize the measurement configuration
- **Remote Commands for R&S VSE Pulse application Measurements**
  Remote commands required to configure and perform R&S VSE Pulse application measurements in a remote environment, sorted by tasks
  (Commands required to set up the environment or to perform common tasks in the software are provided in the R&S VSE Base Software User Manual)
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **List of remote commands**
  Alphahabetical list of all remote commands described in the manual
- **Index**

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 Welcome to the Pulse Measurements Application

The R&S VSE-K6 is a firmware application that adds functionality to perform measurements on pulsed signals to the R&S VSE.

The R&S VSE Pulse application provides measurement and analysis functions for pulse signals frequently used in radar applications, for example.

The R&S VSE Pulse application features:

- Measurement of basic pulse characteristics
- Analysis of parameter trends over time
- Display of amplitude, frequency and phase measurement traces for individual pulses

This user manual contains a description of the functionality that the application provides, including remote control operation.

Functions that are not discussed in this manual are the same as in the Spectrum application and are described in the R&S VSE Base Software User Manual. The latest version is available for download at the product homepage (http://www2.rohde-schwarz.com/product/VSE.html).

2.1 Starting the Pulse Application

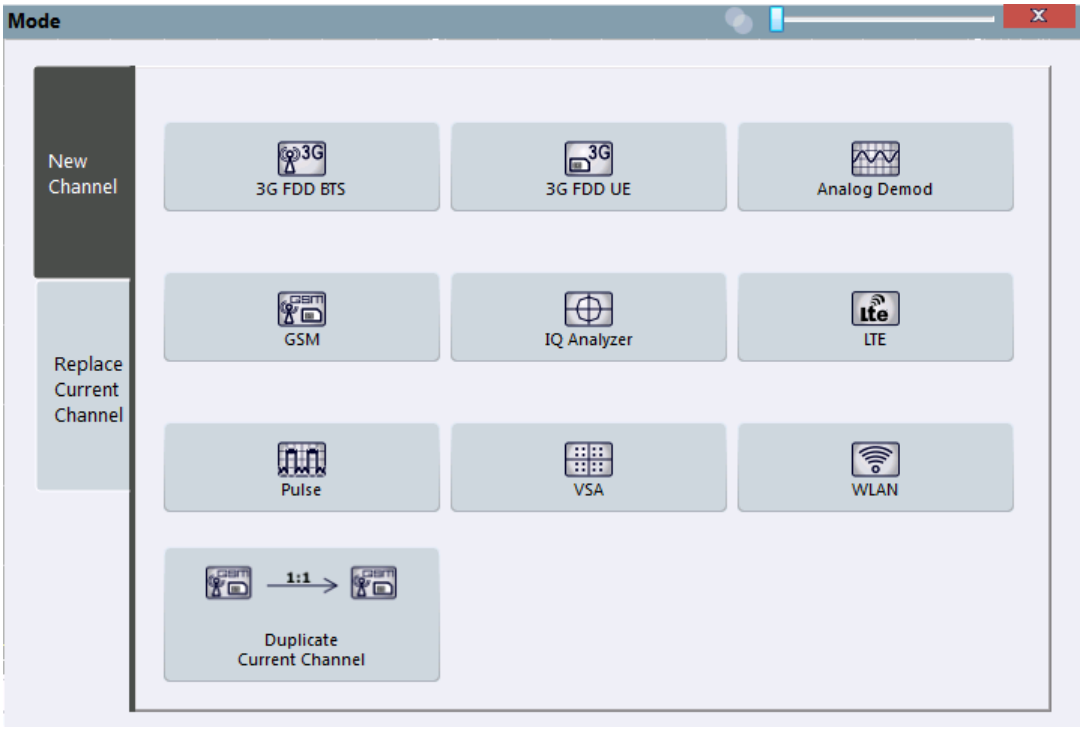
Pulse measurements require a separate application on the R&S VSE. It is activated by creating a new measurement channel in Pulse mode.

To activate the Pulse application

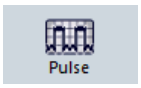
1.

   Select the "Add Channel" function in the Sequence tool window.

   A dialog box opens that contains all operating modes and applications currently available in your R&S VSE.



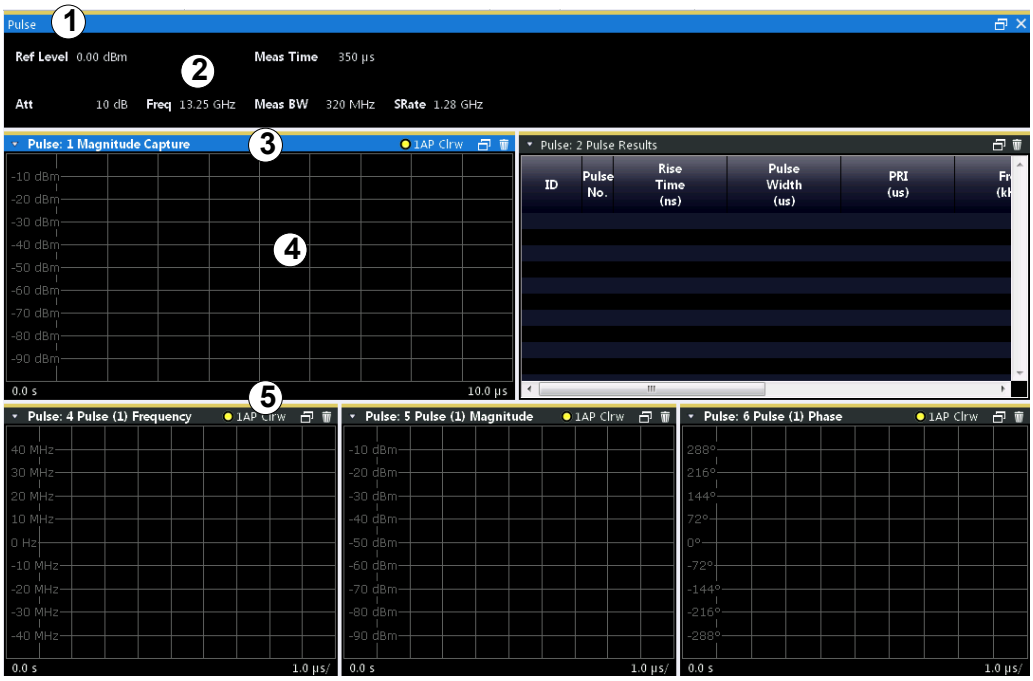
2. Select the "Pulse" item.



The R&S VSE opens a new measurement channel for the R&S VSE Pulse application.

2.2 Understanding the Display Information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Color coding for windows of same channel
2 = Channel bar with measurement settings
3 = Window title bar with diagram-specific (trace) information
4 = Diagram area
5 = Diagram footer with diagram-specific information, depending on result display

Channel bar information

In the Pulse application, the R&S VSE shows the following settings:

Table 2-1: Information displayed in the channel bar in the Pulse application

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation (if available)
Freq	Center frequency for the RF signal
Meas Time	Measurement time (data acquisition time)
Meas BW	Measurement bandwidth
SRate	Sample rate

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S VSE Base Software User Manual.

Window title bar information

For each diagram, the header provides the following information:

Fig. 2-1: Window title bar information in the Pulse application

0 = Color coding for windows of same channel
1 = Edit result display function
2 = Channel name
3 = Window number
4 = Window type (+ pulse number for pulse-based displays)
5 = Trace color, trace number, trace detector, trace mode
6 = Dock/undock window function
7 = Close window function

Diagram area

The diagram area displays the results according to the selected result displays (see chapter 3.2, "Evaluation Methods for Pulse Measurements", on page 20).

Diagram footer information

The diagram footer (beneath the diagram) contains the start and stop values for the displayed time range.

Status bar information

The software status, errors and warnings and any irregularities in the software are indicated in the status bar at the bottom of the R&S VSE window.

3 Measurements and Result Displays

During a pulse measurement, I/Q data from the input signal is captured for a specified time or for a specified record length. Pulses are detected from the signal according to specified thresholds and user-defined criteria. The measured signal is then compared with the ideal signal described by the user and any deviations are recorded. The defined range of measured data is then evaluated to determine characteristic pulse parameters. These parameters can either be displayed as traces, in a table, or be evaluated statistically over a series of measurements.

Measurement range vs result range

The **measurement range** defines which part of a pulse is measured (for example for frequency deviation), whereas the **result range** determines which data is **displayed** on the screen in the form of amplitude, frequency or phase vs. time traces.

Result display windows

For each measurement, a separate measurement channel is activated. Each measurement channel can provide multiple result displays, which are displayed in individual windows. The measurement windows can be rearranged and configured in the R&S VSE to meet your requirements. All windows that belong to the same measurement (including the channel bar) are indicated by a colored line at the top of the window title bar.

► To add further result displays for the Pulse channel, select the "Add Window" icon from the toolbar, or select the "Window > New Window" menu item.

For details on working with channels and windows see the "Operating Basics" chapter in the R&S VSE Base Software User Manual.

- Pulse Parameters.....11
- Evaluation Methods for Pulse Measurements.....20

3.1 Pulse Parameters

The pulse parameters to be measured are based primarily on the IEEE 181 Standard 181-2003. For detailed descriptions refer to the standard documentation ("IEEE Standard on Transitions, Pulses, and Related Waveforms", from the IEEE Instrumentation and Measurement (I&M) Society, 7 July 2003).

The following graphic illustrates the main pulse parameters and characteristic values. (For a definition of the values used to determine the measured pulse parameters see chapter 4.1, "Parameter Definitions", on page 32.)

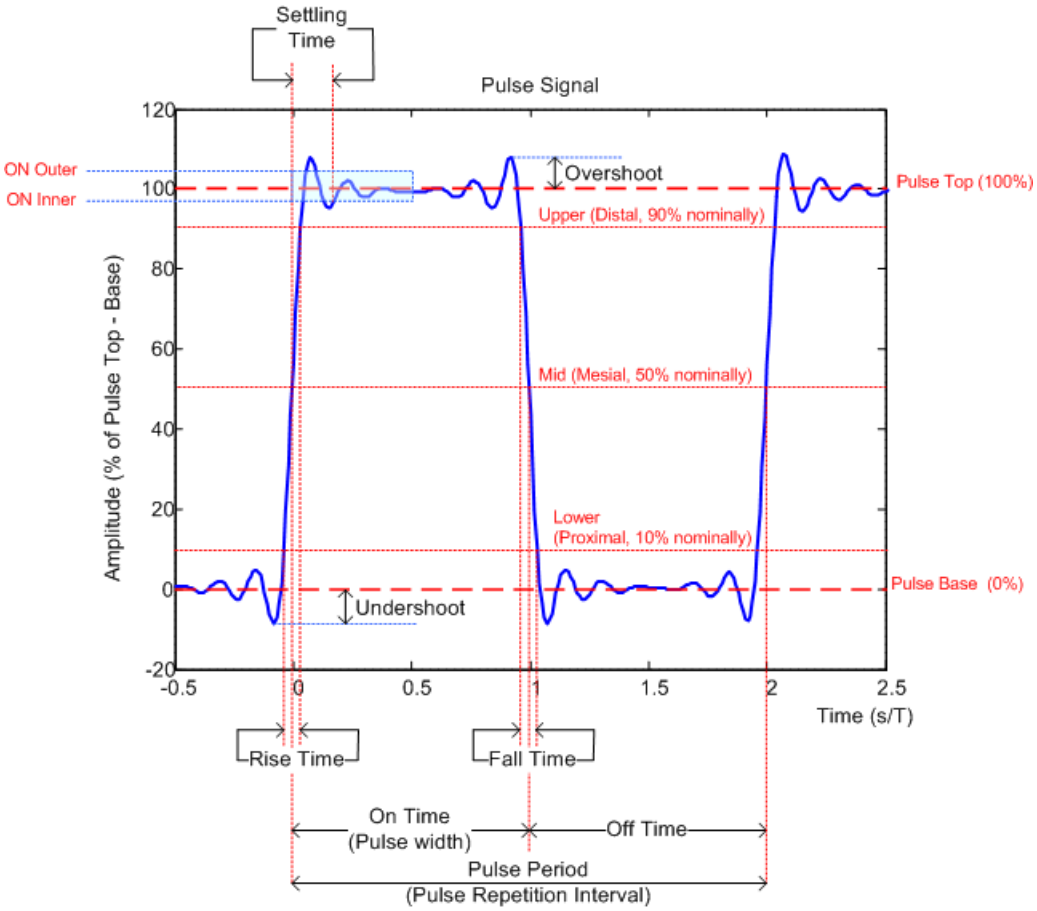


Fig. 3-1: Definition of the main pulse parameters and characteristic values

In order to obtain these results, select the corresponding parameter in the result configuration (see chapter 6.1, "Result Configuration", on page 71) or apply the required SCPI parameter to the remote command (see chapter 8.4.10, "Configuring the Results", on page 144 and chapter 8.6.1, "Retrieving Results", on page 207).

- Timing Parameters....12
- Power/Amplitude Parameters....15
- Frequency Parameters....18
- Phase Parameters....19

3.1.1 Timing Parameters

The following timing parameters can be determined by the R&S VSE Pulse application.

Timestamp....13
Settling Time....13
Rise Time....13
Fall Time....13
Pulse Width (ON Time)....13
Off Time....14
Duty Ratio....14

Duty Cycle (%)..... 14
Pulse Repetition Interval..... 14
Pulse Repetition Frequency (Hz)..... 14

Timestamp
The time stamp uniquely identifies each pulse in the capture buffer. It is defined as the time from the capture start point to the beginning of the pulse period of the current pulse. Depending on the user-specified definition of the pulse period, the period begins with the mid-level crossing of the current pulse's rising edge (period: high-to-low) or the mid-level crossing of the previous pulse's falling edge (period low-to-high). See also "Pulse Period" on page 45.

Remote command:
`[SENSe:]PULSe:TIMing:TSTamp?` on page 231
`CALCulate<n>:TABLe:TIMing:TSTamp` on page 185

Settling Time
The difference between the time at which the pulse exceeds the mid threshold on the rising edge to the point where the pulse waveform remains within the pulse boundary (ON Inner/ ON Outer)

See figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:SETTling?` on page 230
`CALCulate<n>:TABLe:TIMing:SETTling` on page 185

Rise Time
The time required for the pulse to transition from the base to the top level. This is the difference between the time at which the pulse exceeds the lower and upper thresholds.

See figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:RISE?` on page 229
`CALCulate<n>:TABLe:TIMing:RISE` on page 184

Fall Time
The time required for the pulse to transition from the top to the base level. This is the difference between the time at which the pulse drops below the upper and lower thresholds.

See figure 3-1

Remote command:
`[SENSe:]PULSe:TIMing:FALL?` on page 226
`CALCulate<n>:TABLe:TIMing:FALL` on page 183

Pulse Width (ON Time)
The time that the pulse remains at the top level ("ON"). This is the time between the first positive edge and the subsequent negative edge of the pulse in seconds, where the edges occur at crossings of the mid threshold.

See figure 3-1

Remote command:
[SENSe:]PULSe:TIMing:PWIDth? on page 229
CALCulate<n>:TABLe:TIMing:PWIDth on page 184

Off Time
The time that the pulse remains at the base level ("OFF"). This is the time between the first negative edge and the subsequent positive edge of the pulse in seconds, where the edges occur at crossings of the mid threshold.

See figure 3-1

Remote command:
[SENSe:]PULSe:TIMing:OFF? on page 227
CALCulate<n>:TABLe:TIMing:OFF on page 183

Duty Ratio
The ratio of the "Pulse Width" to "Pulse Repetition Interval" expressed as a value between 0 and 1 (requires at least two measured pulses)

Remote command:
[SENSe:]PULSe:TIMing:DRATio? on page 225
CALCulate<n>:TABLe:TIMing:DRATio on page 183

Duty Cycle (%)
The ratio of the "Pulse Width" to "Pulse Repetition Interval" expressed as a percentage (requires at least two measured pulses)

Remote command:
[SENSe:]PULSe:TIMing:DCYCle? on page 225
CALCulate<n>:TABLe:TIMing:DCYCle on page 183

Pulse Repetition Interval
The time between two consecutive edges of the same polarity in seconds (requires at least two measured pulses). The user-specified definition of the pulse period (see"Pulse Period" on page 45) determines whether this value is calculated from consecutive rising or falling edges.

Remote command:
[SENSe:]PULSe:TIMing:PRI? on page 228
CALCulate<n>:TABLe:TIMing:PRI on page 184

Pulse Repetition Frequency (Hz)
The frequency of occurrence of pulses, i.e. inverse of the "Pulse Repetition Interval" (requires at least two measured pulses)

Remote command:
[SENSe:]PULSe:TIMing:PRF? on page 227
CALCulate<n>:TABLe:TIMing:PRF on page 184

3.1.2 Power/Amplitude Parameters

The following power/amplitude parameters can be determined by the R&S VSE Pulse application.

Top Power....15
Base Power....15
Pulse Amplitude....15
Average ON Power....15
Average Tx Power....16
Minimum Power....16
Peak Power....16
Peak-to-Avg ON Power Ratio....16
Peak-to-Average Tx Power Ratio....16
Peak-to-Min Power Ratio....16
Droop....16
Ripple....17
Overshoot....17
Power (at Point)....17
Pulse-to-Pulse Power Ratio....17

Top Power
The median pulse ON power. The value of this parameter is used as a reference (100%) to determine other parameter values such as the rising / falling thresholds. Various algorithms are provided to determine the top power (see "Measurement Algorithm" on page 66).

Remote command:
`[SENSe:]PULSe:POWer:TOP?` on page 223
`CALCulate<n>:TABLe:POWer:TOP` on page 182

Base Power
The median pulse OFF power. The value of this parameter is used as a reference (0%) to determine other parameter values such as the rising / falling thresholds.

Remote command:
`[SENSe:]PULSe:POWer:BASE?` on page 214
`CALCulate<n>:TABLe:POWer:BASE` on page 180

Pulse Amplitude
The difference between the "Top Power" and the "Base Power". This value determines the 100% power range (amplitude).

Remote command:
`[SENSe:]PULSe:POWer:AMPLitude?` on page 213
`CALCulate<n>:TABLe:POWer:AMPLitude` on page 179

Average ON Power
The average power during the pulse ON time

Remote command:
`[SENSe:]PULSe:POWer:ON?` on page 216
`CALCulate<n>:TABLe:POWer:ON` on page 180

Average Tx Power
The average transmission power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:AVG? on page 213
CALCulate<n>:TABLe:POWer:AVG on page 179

Minimum Power
The minimum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:MIN? on page 215
CALCulate<n>:TABLe:POWer:MIN on page 180

Peak Power
The maximum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:MAX? on page 215
CALCulate<n>:TABLe:POWer:MAX on page 180

Peak-to-Avg ON Power Ratio
The ratio of maximum to average power over the pulse ON time (also known as **crest factor**)

Remote command:
[SENSe:]PULSe:POWer:PON? on page 220
CALCulate<n>:TABLe:POWer:PON on page 181

Peak-to-Average Tx Power Ratio
The ratio of maximum to average power over the entire pulse ON + OFF interval.

Remote command:
[SENSe:]PULSe:POWer:PAVG? on page 218
CALCulate<n>:TABLe:POWer:PAVG on page 181

Peak-to-Min Power Ratio
The ratio of maximum to minimum power over the entire pulse ON + OFF time

Remote command:
[SENSe:]PULSe:POWer:PMIN? on page 219
CALCulate<n>:TABLe:POWer:PMIN on page 181

Droop
The rate at which the pulse top level decays, calculated as the difference between the power at the beginning of the pulse ON time and the power at the end of the pulse ON time, divided by the pulse amplitude.

Droop values are only calculated if Pulse Has Droop is set to "On" (default behaviour).

For more information see chapter 4.1.1, "Amplitude Droop", on page 33

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 66), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:ADRoop:DB? on page 211
[SENSe:]PULSe:POWer:ADRoop[:PERCent]? on page 212
CALCulate<n>:TABLe:POWer:ADRoop:DB on page 179
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] on page 179

Ripple
The ripple is calculated as the difference between the maximum and minimum deviation from the pulse top reference, within a user specified interval.

For more information see chapter 4.1.2, "Ripple", on page 33

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 66), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:RIPPle:DB? on page 222
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? on page 222
CALCulate<n>:TABLe:POWer:RIPPle:DB on page 182
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] on page 182

Overshoot
The height of the local maximum after a rising edge, divided by the pulse amplitude.

For more information see chapter 4.1.3, "Overshoot", on page 35.

Note: The percentage ratio values are calculated in %V if the "Measurement Level" is defined in V (see "Reference Level Unit" on page 66), otherwise in %W.

Remote command:
[SENSe:]PULSe:POWer:OVERshoot:DB? on page 217
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? on page 217
CALCulate<n>:TABLe:POWer:OVERshoot:DB on page 180
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] on page 181

Power (at Point)
The power measured at the pulse "measurement point" specified by the Measurement Point Reference and the "Offset" on page 68

Remote command:
[SENSe:]PULSe:POWer:POINt? on page 219
CALCulate<n>:TABLe:POWer:POINt on page 181

Pulse-to-Pulse Power Ratio
The ratio of the "Power" values from the first measured pulse to the current pulse.

Remote command:
[SENSe:]PULSe:POWer:PPRatio? on page 221
CALCulate<n>:TABLe:POWer:PPRatio on page 182

3.1.3 Frequency Parameters

The following frequency parameters can be determined by the R&S VSE Pulse application.

Frequency 18
Pulse-Pulse Frequency Difference 18
Frequency Error (RMS) 18
Frequency Error (Peak) 18
Frequency Deviation 18
Chirp Rate 19

Frequency
Frequency of the pulse measured at the defined Measurement Point

Remote command:
`[SENSe:]PULSe:FREQuency:POINt?` on page 234
`CALCulate<n>:TABLe:FREQuency:POINt` on page 176

Pulse-Pulse Frequency Difference
Difference in frequency between the first measured pulse and the currently measured pulse

Remote command:
`[SENSe:]PULSe:FREQuency:PPFRequency?` on page 235
`CALCulate<n>:TABLe:FREQuency:PPFRequency` on page 177

Frequency Error (RMS)
The RMS frequency error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for modulation type "Arbitrary". The error is calculated over the Measurement Range.

Remote command:
`[SENSe:]PULSe:FREQuency:RERRor?` on page 236
`CALCulate<n>:TABLe:FREQuency:RERRor` on page 177

Frequency Error (Peak)
The peak frequency error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for modulation type "Arbitrary". The error is calculated over the Measurement Range.

Remote command:
`[SENSe:]PULSe:FREQuency:PERRor?` on page 234
`CALCulate<n>:TABLe:FREQuency:PERRor` on page 176

Frequency Deviation
The frequency deviation of the currently measured pulse. The deviation is calculated as the absolute difference between the maximum and minimum frequency values within the Measurement Range.

Remote command:
`[SENSe:]PULSe:FREQuency:DEViation?` on page 233
`CALCulate<n>:TABLe:FREQuency:DEViation` on page 176

Chirp Rate
A known frequency chirp rate (per µs) to be used for generating an ideal pulse waveform.

Note: a chirp rate is only available for the Pulse Modulation type "Linear FM".

Remote command:
`[SENSe:]PULSe:FREQuency:CRATe?` on page 232
`CALCulate<n>:TABLe:FREQuency:CRATe` on page 176

3.1.4 Phase Parameters

The following phase parameters can be determined by the R&S VSE Pulse application.

Phase....19
Pulse-Pulse Phase Difference....19
Phase Error (RMS)....19
Phase Error (Peak)....19
Phase Deviation....20

Phase
Phase of the pulse measured at the defined Measurement Point

Remote command:
`[SENSe:]PULSe:PHASe:POINt?` on page 238
`CALCulate<n>:TABLe:PHASe:POINt` on page 178

Pulse-Pulse Phase Difference
Difference in phase between the first measured pulse and the currently measured pulse

Remote command:
`[SENSe:]PULSe:PHASe:PPPHase?` on page 239
`CALCulate<n>:TABLe:PHASe:PPPHase` on page 178

Phase Error (RMS)
The RMS phase error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for the Pulse Modulation type "Arbitrary". The error is calculated over the Measurement Range.

Remote command:
`[SENSe:]PULSe:PHASe:RERRor?` on page 240
`CALCulate<n>:TABLe:PHASe:RERRor` on page 178

Phase Error (Peak)
The peak phase error of the currently measured pulse. The error is calculated relative to the given pulse modulation. It is not calculated at all for the Pulse Modulation type "Arbitrary". The error is calculated over the Measurement Range.

Remote command:
`[SENSe:]PULSe:PHASe:PERRor?` on page 237
`CALCulate<n>:TABLe:PHASe:PERRor` on page 178

Phase Deviation
The phase deviation of the currently measured pulse. The deviation is calculated as the absolute difference between the maximum and minimum phase values within the Measurement Range.

Remote command:
`[SENSe:]PULSe:PHASe:DEViation?` on page 237
`CALCulate<n>:TABLe:PHASe:DEViation` on page 178

3.2 Evaluation Methods for Pulse Measurements

The data that was measured by the R&S VSE Pulse application can be evaluated using various different methods.

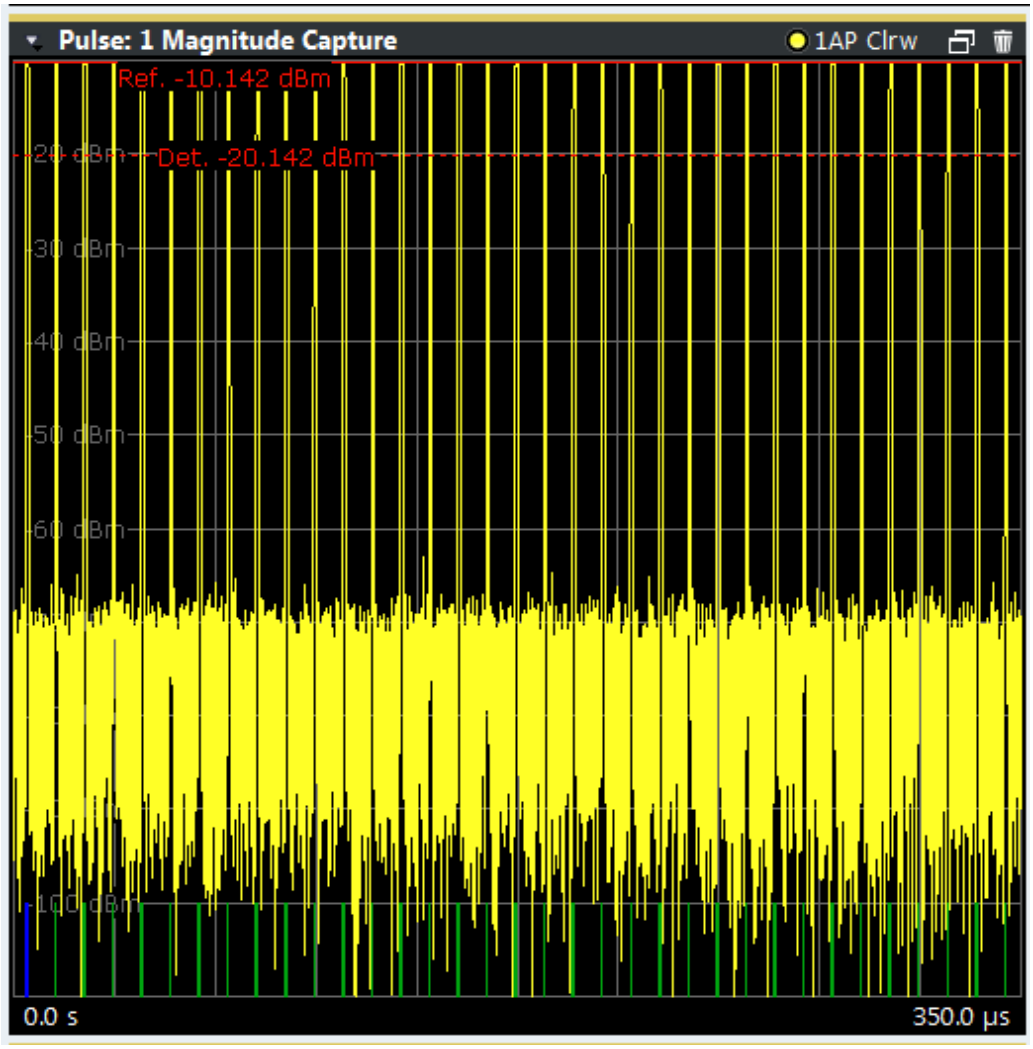
By default, the Pulse measurement results are displayed in the following windows:

- Magnitude Capture
- Pulse Results
- Pulse Frequency
- Pulse Magnitude
- Pulse Phase

The following evaluation methods are available for Pulse measurements:

Magnitude Capture....20
Marker Table....21
Parameter Distribution....22
Parameter Spectrum....23
Parameter Trend....23
Pulse Frequency....25
Pulse Magnitude....25
Pulse Phase....26
Pulse Phase (Wrapped)....27
Pulse Results....28
Pulse Statistics....30

Magnitude Capture
Displays the captured data. Detected pulses are indicated by green bars along the x-axis. The currently selected pulse is highlighted in blue. Additionally, the pulse detection reference level is indicated ("Ref"), as well as the specified pulse detection threshold ("Det").



Remote command:
`LAY:ADD:WIND '2',RIGH,MCAP` see `LAYout:ADD[:WINDow]?` on page 139
Results:
`TRACe<n>[:DATA]?` on page 207

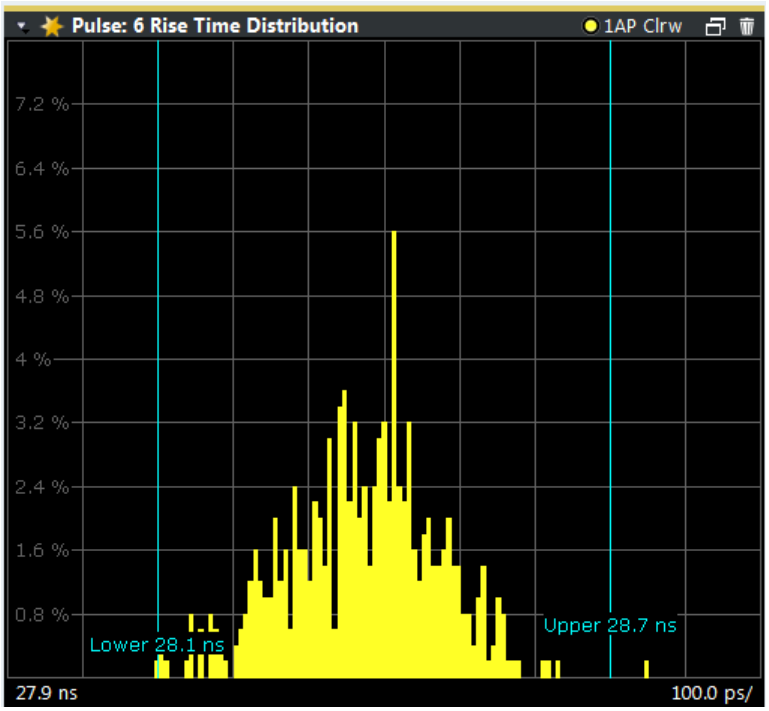
Marker Table
Displays a table with the current marker values for the active markers.

Wnd	Type	Ref	X-Value	Y-Value
1	M1		0.256	0.00 dB
1	D2	M1	415.512	-1.94 dB
1	D3	M1	489.512	-1.95 dB
1	D4	M1	266.512	-2.00 dB

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 139
Results:
`CALCulate<n>:MARKer<m>:X` on page 198
`CALCulate<n>:MARKer<m>:Y?` on page 246

Parameter Distribution
Plots a histogram of a particular parameter, i.e. all measured parameter values from the current capture vs pulse count or occurrence in %. Thus you can determine how often a particular parameter value occurs. For each parameter distribution window you can configure a different parameter to be displayed.

This evaluation method allows you to distinguish transient and stable effects in a specific parameter, such as a spurious frequency deviation or a fluctuation in power over several pulses.

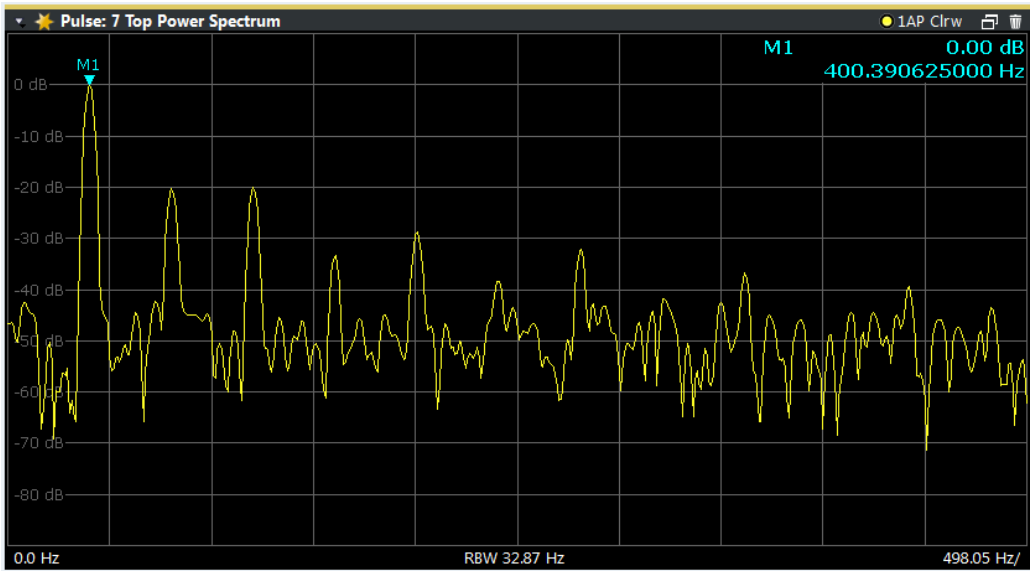


Note that averaging is not possible for parameter distribution traces.

Remote command:
`LAY:ADD:WIND '2',RIGH,PDIS` see `LAYout:ADD[:WINDow]?` on page 139
chapter 8.4.10.3, "Configuring a Parameter Distribution", on page 147
Results:
`TRACe<n>[:DATA]?` on page 207

Parameter Spectrum
Calculates an FFT for a selected column of the Pulse Results table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters. For example, the Parameter Spectrum for "Pulse Top Power" might display a peak at a particular frequency, indicating incidental amplitude modulation of the amplifier output due to the power supply.

The Parameter Spectrum is calculated by taking the magnitude of the FFT of the selected parameter and normalizing the result to the largest peak. In order to calculate the frequency axis the average PRI (pulse repetition interval) is taken to be the "sample rate" for the FFT. Note that in cases where the signal has a non-uniform or staggered PRI the frequency axis must therefore be interpreted with caution.



Remote command:
`LAY:ADD:WIND '2',RIGH,PSP` see `LAYout:ADD[:WINDow]?` on page 139
chapter 8.4.10.4, "Configuring a Parameter Spectrum", on page 152
Results:
`TRACe<n>[:DATA]?` on page 207

Parameter Trend
Plots all measured parameter values from the current capture vs pulse number or pulse timestamp. This is equivalent to plotting a column of the "Pulse Results" table for the rows highlighted green. This evaluation allows you to determine trends in a specific parameter, such as a frequency deviation or a fluctuation in power over several pulses.

The parameter trend evaluation can also be used for a more general scatter plot - the parameters from the current capture can not only be displayed over time, but also versus any other pulse parameter. For example, you can evaluate the rise time vs fall time.

For each parameter trend window you can configure a different parameter to be displayed for both the x-axis and the y-axis, making this a very powerful and flexible analysis tool.

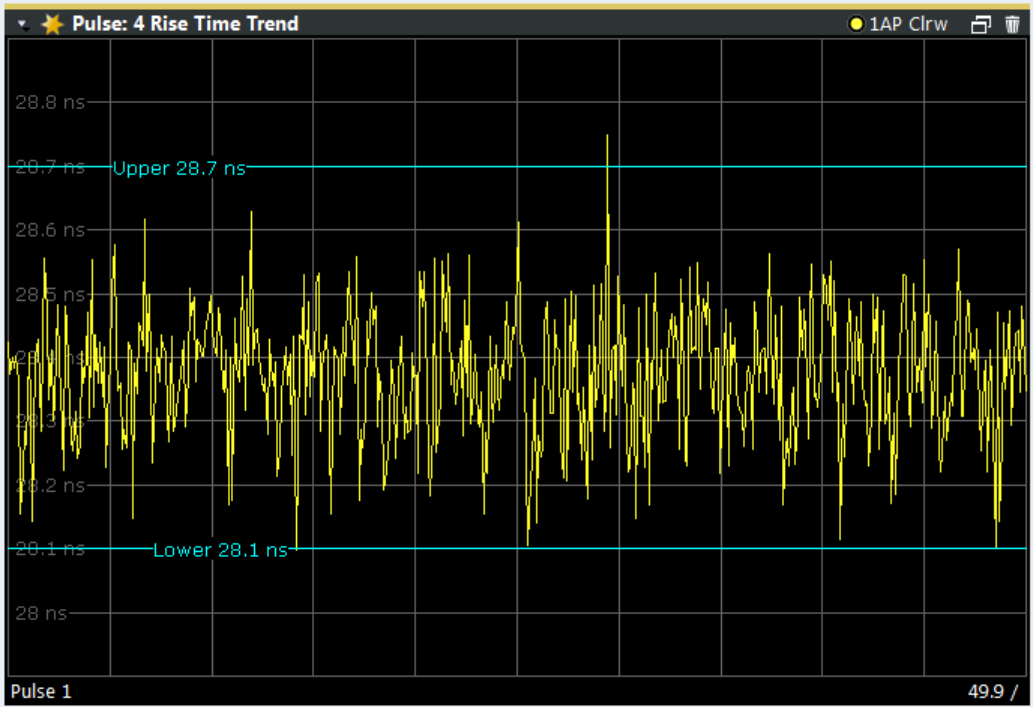


Fig. 3-2: Pulse rise time trend display (over pulse numbers)

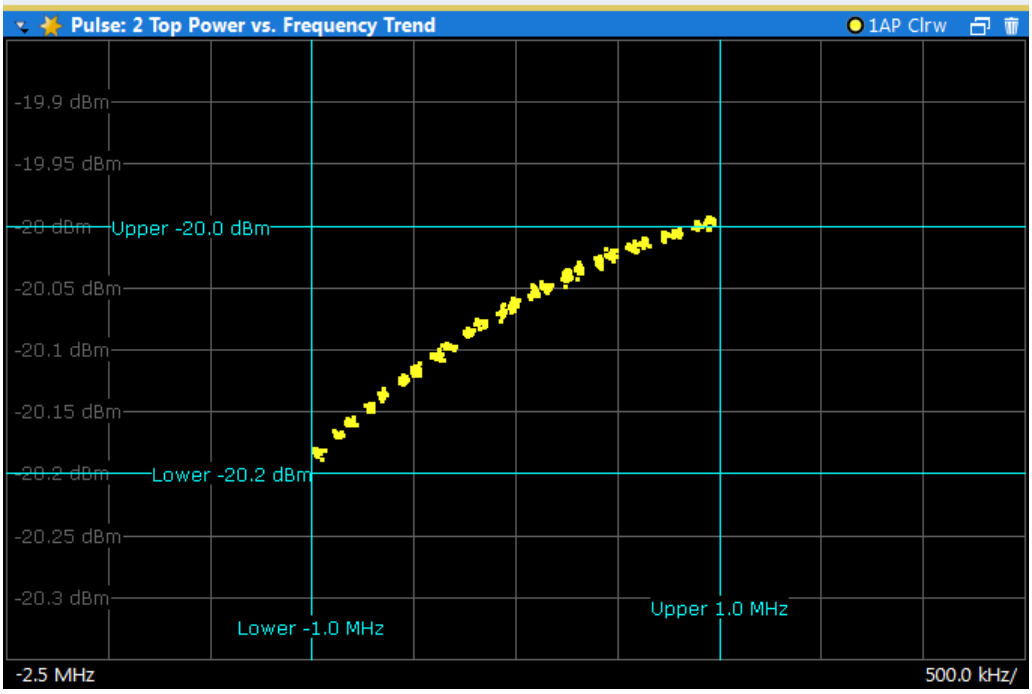


Fig. 3-3: Top power vs frequency scatter plot

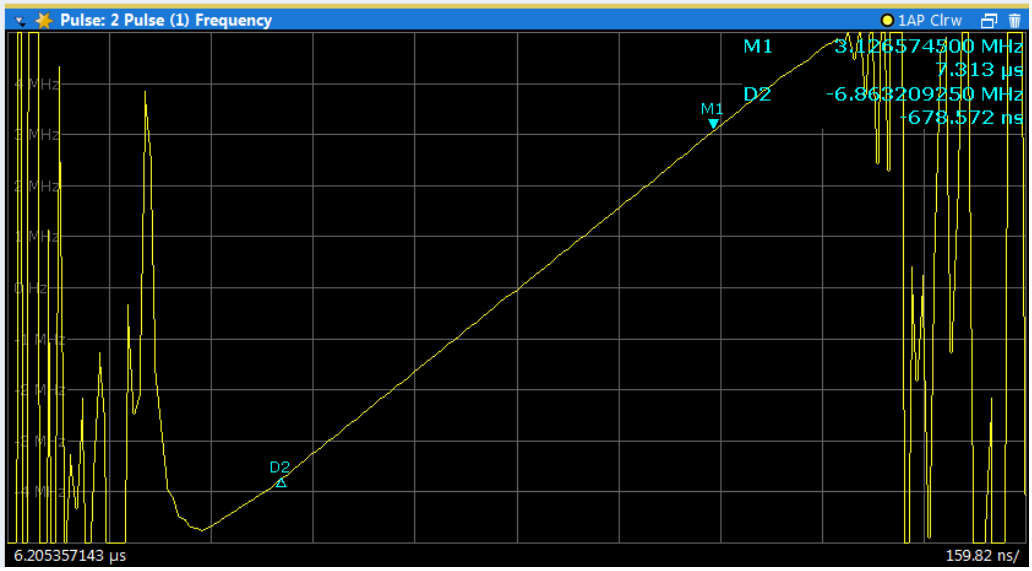
Note that averaging is not possible for parameter trend traces.

Note: Setting markers in Parameter Trend Displays. In Parameter Trend displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its

x-axis value can be very difficult or ambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.
However, the position displayed in the marker information area or the marker table is shown in the defined x-axis unit.

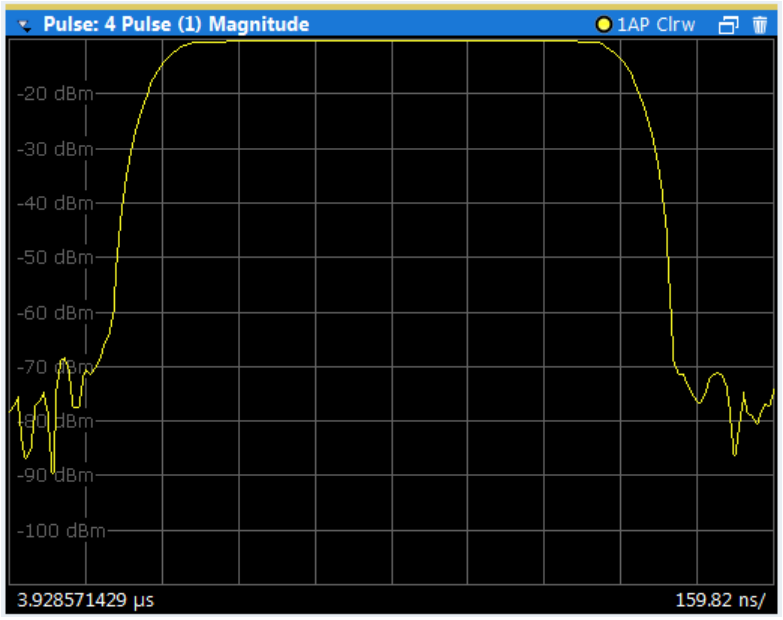
Remote command:
`LAY:ADD:WIND '2',RIGH,PTR` see `LAYout:ADD[:WINDow]?` on page 139
chapter 8.4.10.5, "Configuring a Parameter Trend", on page 157

Pulse Frequency
Displays the frequency trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.8.3, "Measurement Range", on page 68).



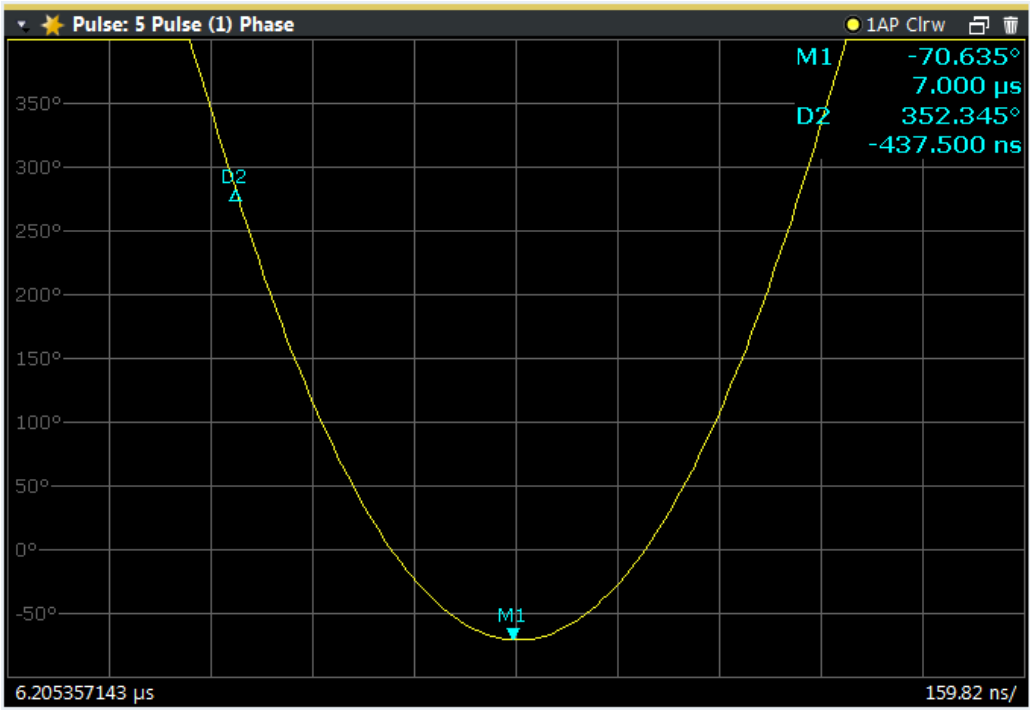
Remote command:
`LAY:ADD:WIND '2',RIGH,PFR` see `LAYout:ADD[:WINDow]?` on page 139
Results:
`TRACe<n>[:DATA]?` on page 207

Pulse Magnitude
Displays the magnitude vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.8.3, "Measurement Range", on page 68).



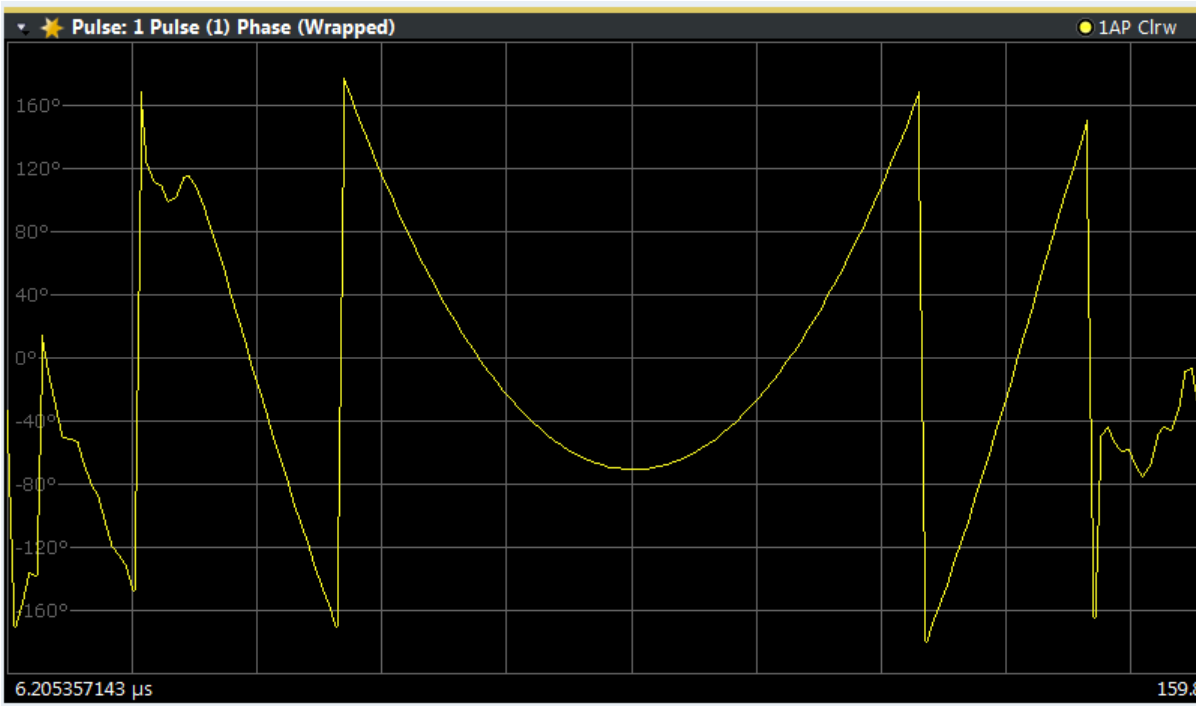
Remote command:
`LAY:ADD:WIND '2',RIGH,PMAG` see `LAYout:ADD[:WINDow]?` on page 139
Results:
`TRACe<n>[:DATA]?` on page 207

Pulse Phase
Displays the phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.8.3, "Measurement Range", on page 68).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPH` see `LAYout:ADD[:WINDow]?` on page 139
Results:
`TRACe<n>[:DATA]?` on page 207

Pulse Phase (Wrapped)
Displays the *wrapped* phase vs. time trace of the selected pulse. The length and alignment of the trace can be configured in the "Measurement Range" dialog box (see chapter 5.8.3, "Measurement Range", on page 68).



Remote command:
`LAY:ADD:WIND '2',RIGH,PPW` see `LAYout:ADD[:WINDow]?` on page 139
Results:
`TRACe<n>[:DATA]?` on page 207

Pulse Results
Displays the measured pulse parameters in a table of results. Which parameters are displayed can be configured in the "Result Configuration" (see chapter 6.1, "Result Configuration", on page 71). The currently selected pulse is highlighted blue. The pulses contained in the current capture buffer are highlighted green.

Pulse: 2 Pulse Results

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
472	20	110.839	0.986	10.000	50.703	-70.708	-10.508	-20.534
473	21	110.572	0.985	10.000	53.878	-70.712	-10.508	-20.534
474	22	110.672	0.985	10.000	52.073	-70.774	-10.509	-20.536
475	23	110.736	0.985	10.000	53.462	-70.734	-10.508	-20.535
476	24	110.776	0.985	10.000	60.349	-70.822	-10.509	-20.535
477	25	110.523	0.985	10.000	56.637	-70.662	-10.508	-20.535
478	26	110.802	0.985	10.000	58.060	-70.762	-10.510	-20.537
479	27	110.653	0.985	10.000	58.756	-70.763	-10.509	-20.535
480	28	110.719	0.985	10.000	54.579	-70.779	-10.508	-20.535
481	29	110.559	0.985	10.000	48.852	-70.771	-10.509	-20.536
482	30	110.496	0.985	10.000	54.130	-70.708	-10.510	-20.536
483	31	110.704	0.985	10.000	55.071	-70.769	-10.509	-20.535
484	32	110.986	0.985	10.000	52.995	-70.730	-10.510	-20.537
485	33	110.736	0.985	10.000	53.463	-70.704	-10.508	-20.535
486	34	110.667	0.985	10.000	59.003	-70.701	-10.509	-20.535
487	35	110.550	0.986	...	60.359	-70.763	-10.509	...
488	1	110.810	0.985	10.000	59.849	-70.599	-10.510	-20.536
489	2	110.862	0.985	10.000	57.452	-70.582	-10.510	-20.536
490	3	110.701	0.985	10.000	50.251	-70.588	-10.509	-20.536
491	4	110.735	0.985	10.000	56.999	-70.647	-10.508	-20.535
492	5	110.726	0.985	10.000	59.952	-70.556	-10.508	-20.535
493	6	110.648	0.985	10.000	51.798	-70.644	-10.508	-20.534
494	7	110.996	0.985	10.000	55.450	-70.561	-10.510	-20.536
495	8	110.564	0.986	10.000	58.288	-70.615	-10.509	-20.535
496	9	110.716	0.985	10.000	62.697	-70.707	-10.509	-20.536
497	10	110.560	0.985	10.000	57.008	-70.613	-10.508	-20.535
498	11	110.720	0.985	10.000	49.939	-70.627	-10.511	-20.537
499	12	110.595	0.986	10.000	44.979	-70.590	-10.509	-20.535
500	13	110.733	0.986	10.000	53.278	-70.542	-10.509	-20.535
501	14	110.570	0.985	10.000	62.036	-70.686	-10.509	-20.536
502	15	110.585	0.985	10.000	47.378	-70.655	-10.509	-20.535
503	16	110.747	0.985	10.000	57.965	-70.663	-10.509	-20.535
504	17	110.741	0.985	10.000	46.735	-70.732	-10.509	-20.536

Limit check

Optionally, the measured results can be checked against defined limits (see chapter 6.1.4.2, "Limit Settings for Table Displays", on page 82). The results of the limit check are indicated in the Pulse Results table as follows:

Table 3-1: Limit check results in the result tables

Display color	Limit check result
white	No limit check active for this parameter
green	Limit check passed
red, asterisk before	Limit check failed; limit exceeds lower limit
red, asterisk behind	Limit check failed; limit exceeds upper limit

Pulse: 1 Pulse Results

ID	Pulse No.	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Top Power (dBm)	Avg Tx Power (dBm)
279	279	28.497	2.000	100.000	-185.186	-90.541	-20.080	-37.097
280	280	28.327	2.000	100.000	-336.088	-124.057	-20.098	-37.113
281	281	28.343	2.000	100.000	-500.288	-162.700	-20.118	-37.134
282	282	28.240	2.000	100.000	-645.834	153.910	-20.135	-37.151
283	283	28.353	2.000	100.000	-826.125	105.563	-20.157	-37.174
284	284	28.220	2.000	100.000	-977.370	52.446	-20.180	-37.196
285	285	28.179	2.000	100.000	-869.769	-123.729	-20.167	-37.184
286	286	28.420	2.000	100.000	-707.488	-121.449	-20.146	-37.159
287	287	28.238	2.000	100.000	-568.670	-115.935	-20.127	-37.141
288	288	28.512	2.000	100.000	-393.288	-105.602	-20.105	-37.121
289	289	28.323	2.000	100.000	-224.176	-90.944	-20.088	-37.104
290	290	28.361	2.000	100.000	-70.966	-70.802	-20.077	-37.087
291	291	28.420	2.000	100.000	89.549	-45.366	-20.055	-37.071
292	292	28.516	2.000	100.000	245.758	-13.922	-20.044	-37.059
293	293	28.284	2.000	100.000	412.287	22.111	-20.033	-37.047
294	294	28.341	2.000	100.000	570.037	63.380	-20.017	-37.032
295	295	28.750*	2.000	100.000	730.199	109.231	-20.007	-37.022
296	296	28.259	2.000	100.000	889.857	159.904	-19.999*	-37.014
297	297	28.412	2.000	100.000	945.233	1.503	-19.993*	-37.011
298	298	28.420	2.000	100.000	801.817	2.533	-20.006	-37.020
299	299	28.311	2.000	100.000	628.363	-1.439	-20.013	-37.027
300	300	28.526	2.000	100.000	442.162	-9.355	-20.024	-37.039
301	301	28.407	2.000	100.000	307.592	-21.587	-20.035	-37.050
302	302	28.356	2.000	100.000	126.844	-39.354	-20.050	-37.064
303	303	28.482	2.000	100.000	-23.219	-61.502	-20.062	-37.078
304	304	28.277	2.000	100.000	-148.717	-90.451	-20.077	-37.093
305	305	28.220	2.000	100.000	-331.082	-124.165	-20.099	-37.112
306	306	28.226	2.000	100.000	-475.370	-162.812	-20.116	-37.132
307	307	28.360	2.000	100.000	-649.092	153.619	-20.138	-37.152
308	308	28.346	2.000	100.000	-800.837	105.339	-20.160	-37.175
309	309	28.148	2.000	100.000	-956.082	52.195	-20.181	-37.199
310	310	28.478	2.000	100.000	-882.401	-124.195	-20.170	-37.186

Note: The results of the limit check are for informational purposes only; special events such as stopping the measurement are not available.

Note: Optionally, limit lines can be displayed in the Parameter Distribution and Parameter Trend diagrams. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Remote command:
`LAY:ADD:WIND '2',RIGH,PRES` see `LAYout:ADD[:WINDow]?` on page 139
chapter 8.4.10.6, "Configuring the Statistics and Parameter Tables", on page 174
Results:
chapter 8.6.1.3, "Retrieving Parameter Results", on page 209

Pulse Statistics
Displays statistical values (minimum, maximum, average, standard deviation) for the measured pulse parameters in a table of results. Both the current capture buffer data and the cummulated captured data from a series of measurements are evaluated. The statistics computed only from pulses within the current capture buffer are highlighted green. For reference, the measured parameters from the "Selected Pulse" are also shown, highlighted blue. The displayed parameters are the same as in the Pulse Results and can be configured in the "Result Configuration" (see chapter 6.1, "Result Configuration", on page 71).

Pulse: 3 Pulse Statistics

Statistic	Rise Time (ns)	Pulse Width (us)	PRI (us)	Freq (kHz)	Phase (deg)	Avg ON Power (dBm)	Avg Tx Power (dBm)
Selected	110.810	0.985	10.000	59.849	-70.599	-10.510	-20.536
Average	110.698	0.985	10.000	55.815	-70.632	-10.509	-20.535
Std. Dev.	0.115657	0.000066	0.000069	5.042152	0.046989	0.000866	0.000889
Maximum	111.002	0.986	10.000	66.979	-70.533	-10.507	-20.533
Minimum	110.549	0.985	10.000	44.979	-70.732	-10.511	-20.537
Average	110.698	0.985	10.000	56.273	-70.985	-10.509	-20.535
Std. Dev.	0.125778	0.000060	0.000060	4.457147	0.206569	0.000881	0.000880
Maximum	111.033	0.986	10.000	68.473	-70.533	-10.506	-20.532
Minimum	110.240	0.985	10.000	40.300	-71.488	-10.511	-20.537

Note: Limit checks are also available for Pulse Statistics; see "Pulse Results" on page 28.

Remote command:
`LAY:ADD:WIND '2',RIGH,PST` see `LAYout:ADD[:WINDow]?` on page 139
chapter 8.4.10.6, "Configuring the Statistics and Parameter Tables", on page 174
Results:
chapter 8.6.1.3, "Retrieving Parameter Results", on page 209

4 Measurement Basics

Some background knowledge on basic terms and principles used in pulse measurements is provided here for a better understanding of the required configuration settings.

- Parameter Definitions....32
- Pulse Detection....35
- Parameter Spectrum Calculation....37
- Receiving Data Input and Providing Data Output....40
- Trace Evaluation....41

4.1 Parameter Definitions

The pulse parameters to be measured are based primarily on the IEEE 181 Standard 181-2003. For detailed descriptions refer to the standard documentation ("IEEE Standard on Transitions, Pulses, and Related Waveforms", from the IEEE Instrumentation and Measurement (I&M) Society, 7 July 2003).

The following definitions are used to determine the measured pulse power parameters:

Value	Description
$L_{0\%}$	The magnitude in V corresponding to the pulse OFF level (base level)
$L_{100\%}$	The magnitude in V corresponding to the pulse ON level (top level)
L_{Ov}	The magnitude in V at the peak level occurring directly after the pulse rising edge (mid-level crossing)
L_{rise}	The magnitude in V of the reference model at the top of the rising edge (beginning of the pulse top)
L_{fall}	The magnitude in V of the reference model at the top of the falling edge (end of the pulse top)
L_{rip+}	The magnitude in V corresponding to the largest level above the reference model which occurs within the ripple portion of the pulse top
L_{top+}	The magnitude in V of the reference model at the point in time where L_{rip+} is measured
L_{rip-}	The magnitude in V corresponding to the lowest measured level below the reference model which occurs within the ripple portion of the pulse top
L_{top-}	The magnitude in V of the reference model at the point in time where L_{rip-} is measured

- Amplitude Droop....33
- Ripple....33
- Overshoot....35

4.1.1 Amplitude Droop

The amplitude droop is calculated as the difference between the power at the beginning of the pulse ON time and the power at the end of the pulse ON time, divided by the pulse amplitude:

$$\text{Droop}\,(\%\text{V}) = \frac{L_{rise} - L_{fall}}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Droop}\,(\%\text{W}) = \frac{L^2_{rise} - L^2_{fall}}{L^2_{100\%} - L^2_{0\%}} \times 100$$

$$\text{Droop}\,(\text{dB}) = 20 \times \log_{10}\left(\frac{L_{rise}}{L_{fall}}\right)$$

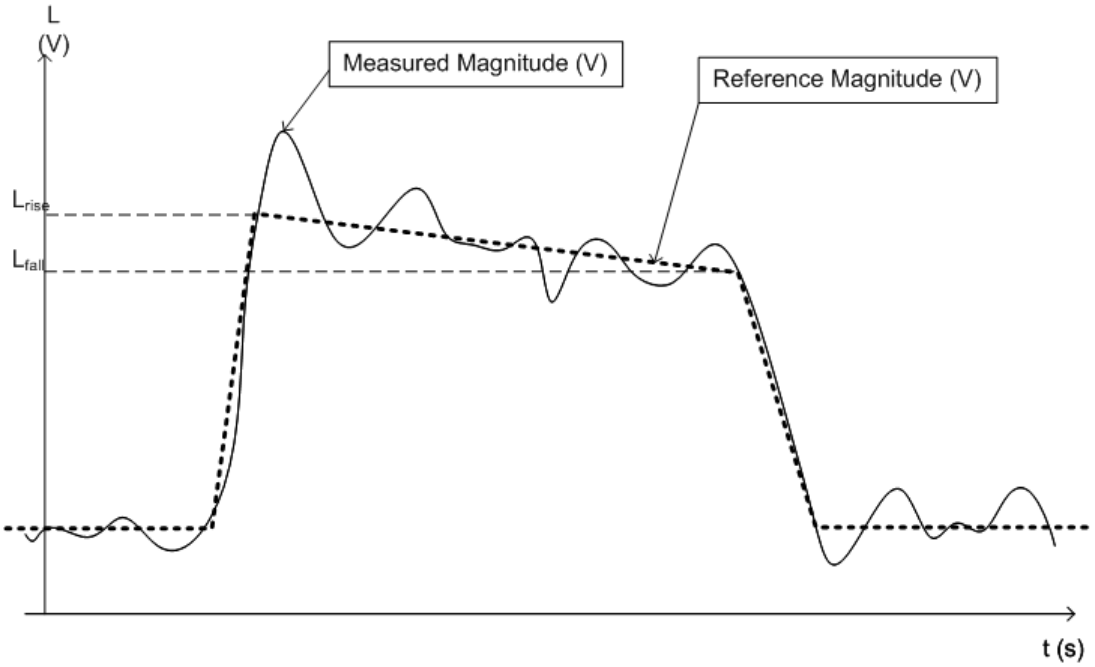


Fig. 4-1: Illustration of levels used to define the droop measurement

4.1.2 Ripple

The ripple is calculated as the difference between the maximum and minimum deviation from the pulse top reference, within a user specified interval.

The default behaviour compensates for droop in the pulse top using the following formulae:

$$\text{Ripple (\%V)} = \frac{\left|L_{rip+} - L_{top+}\right| + \left|L_{top-} - L_{rip-}\right|}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Ripple (\%W)} = \frac{\left|L^2_{rip+} - L^2_{top+}\right| + \left|L^2_{top-} - L^2_{rip-}\right|}{L^2_{100\%} - L^2_{0\%}} \times 100$$

$$\text{Ripple (dB)} = 10 \times \log_{10}\left(\frac{L^2_{100\%} + \left|L^2_{rip+} - L^2_{top+}\right|}{L^2_{100\%} - \left|L^2_{top-} - L^2_{rip-}\right|}\right)$$

However, if Pulse Has Droop is set to "Off" or the 100 % Level Position is set to "Center", then the reference model has a flat pulse top and $L_{top+} = L_{top-} = L_{100\%}$. Thus, the formulae are reduced to:

$$\text{Ripple (\%V)} = \frac{L_{rip+} - L_{rip-}}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Ripple (\%W)} = \frac{L^2_{rip+} - L^2_{rip-}}{L^2_{100\%} - L^2_{0\%}} \times 100$$

$$\text{Ripple (dB)} = 20 \times \log_{10}\left(\frac{L_{rip+}}{L_{rip-}}\right)$$

The following illustration indicates the levels used for calculation.

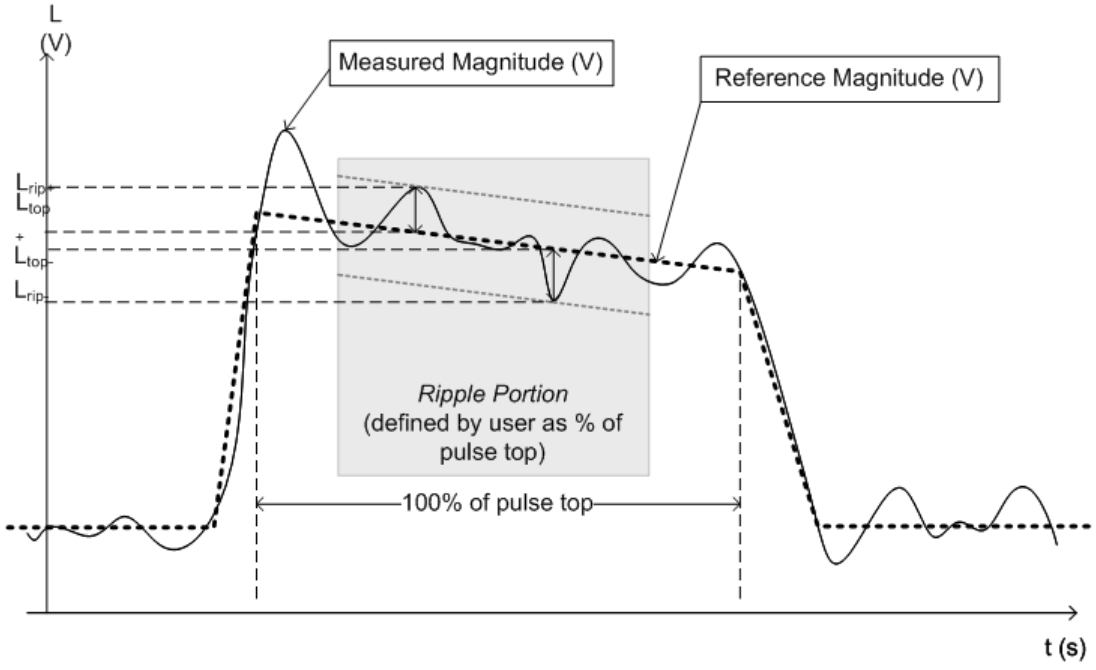


Fig. 4-2: Illustration of levels used to define the ripple measurement.

4.1.3 Overshoot

The overshoot is defined as the height of the local maximum after a rising edge, divided by the pulse amplitude:

$$\text{Overshoot (\%V)} = \frac{L_{Ov} - L_{100\%}}{L_{100\%} - L_{0\%}} \times 100$$

$$\text{Overshoot (\%W)} = \frac{L_{Ov}^2 - L_{100\%}^2}{L_{100\%}^2 - L_{0\%}^2} \times 100$$

$$\text{Overshoot (dB)} = 20 \times \log_{10}\left(\frac{L_{Ov}}{L_{100\%}}\right)$$

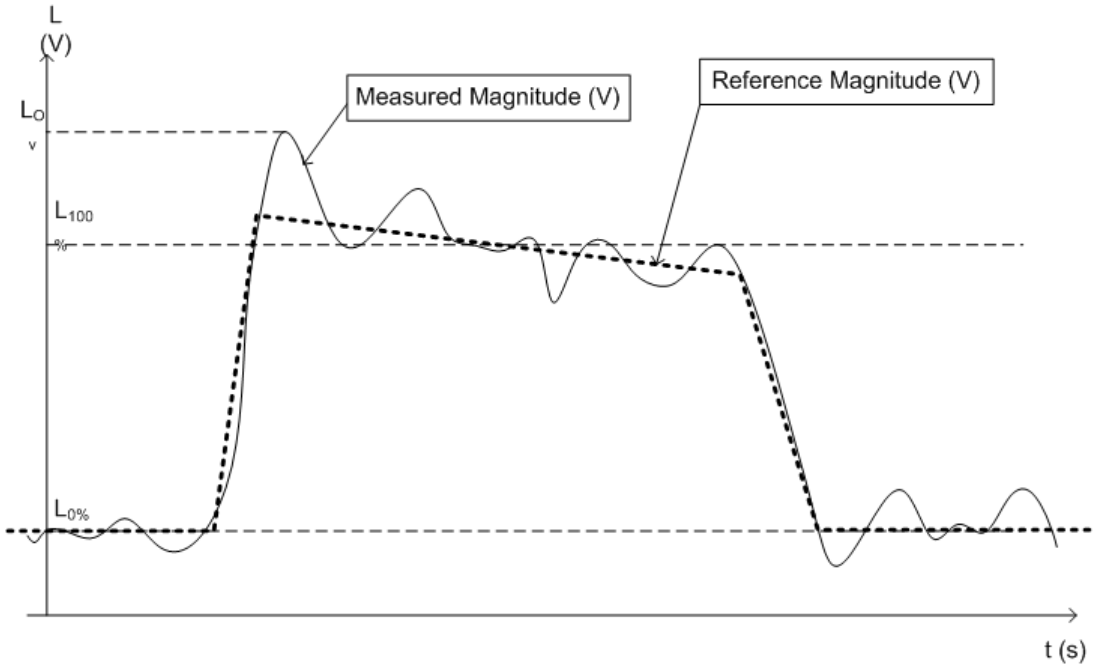
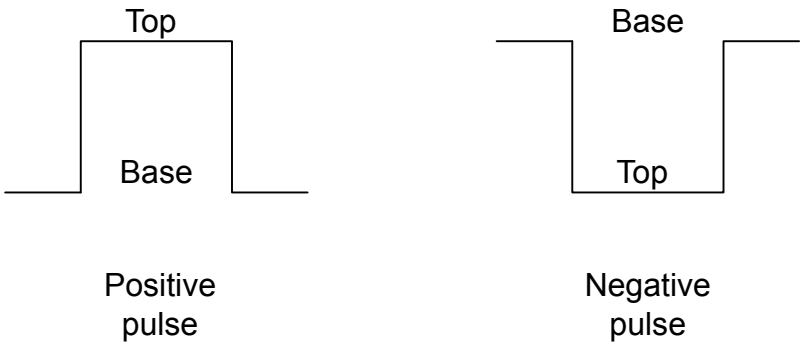


Fig. 4-3: Illustration of levels used to define the overshoot measurement

4.2 Pulse Detection

A pulsed input signal is a signal whose carrier power is modulated by two states: ON and OFF. Basically, a pulse is detected when the input signal power exceeds a threshold, then subsequently falls below that threshold, or vice versa. Pulses that rise to and then remain at a peak (positive) power level for a certain duration, and then fall again are referred to as **positive** pulses, whereas the opposite - falling to and remaining at a minimum (negative) power level, then rising - is referred to as a **negative** pulse. The

"**ON**" power level is referred to as the **top** or **100% level**, whereas the "**OFF**" level is referred to as the **base** or **0% level**.



A **hysteresis** can refine the detection process and avoid falsely interpreting unstable signals as additional pulses. Optionally, detection can be restricted to a maximum number of pulses per capture process.

If the top power level is not constant, this is called an amplitude **droop**. Since the top level is an important reference for several pulse parameters, a droop should be taken into consideration where possible. If a signal is known to have a droop, the reference level is calculated separately for the rising and falling edges, rather than as an average or median value over the ON time.

The time it takes the signal power to rise from the base level to the top is called the **rise time**.

The duration the signal power remains at the top level is considered the **ON time**, which also defines the **pulse width**.

The time it takes the signal power to fall from the top to the base level is called the **fall time**.

The duration the signal power remains at the base level is called the **OFF time**.

The **pulse repetition interval** (also known as **pulse period**) is defined as the duration of one complete cycle consisting of:

- the rise time
- the ON time
- the fall time
- the OFF time

To avoid taking noise, ripples, or other signal instabilites into consideration, threshold values are defined for calculation of these characteristic values rather than using the absolute peak or minimum power values.

More precise definitions and an illustration of how these values are calculated are provided in chapter 3.1, "Pulse Parameters", on page 11.

4.3 Parameter Spectrum Calculation

When a signal is measured over time, it is possible to calculate the frequency spectrum for the measured signal by performing an FFT on the measured data. Silmilarly, it is possible to calculate a "spectrum" for a particular pulse parameter by performing an FFT. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters. For example, the Parameter Spectrum for "Pulse Top Power" might display a peak at a particular frequency, indicating incidental amplitude modulation of the amplifier output due to the power supply.

Basically, the parameter spectrum is calculated by taking the magnitude of the FFT of the selected parameter and normalizing the result to the largest peak.

Frequency axis

When calculating a spectrum from a measured signal, the sample rate ensures a regular distance between two frequencies. In order to calculate the frequency axis for a parameter spectrum, the average PRI (pulse repetition interval) is taken to be the "sample rate" for the FFT.

Interpolation

However, in cases where the signal has a non-uniform or staggered PRI the frequency axis must be interpreted with caution. In cases where the pulses only occur in non-contiguous intervals, using the PRI no longer provides useful results. A good solution to create equi-distant samples for calculation is to "fill up" the intervals between pulses with interpolated values. Based on the measured and interpolated values, the frequency axis can then be created.

The number of possible interpolation values is restricted to 100,000 by the R&S VSE Pulse application . Thus, the resulting spectrum is limited. By default, the frequency span for the resulting spectrum is determined automatically. However, to improve the accuracy (and performance) of the interpolation, the maximum required frequency span can be restricted further manually.

Non-contiguous pulses - sections vs gaps

For the non-contiguous pulse measurements described above, interpolation in the long intervals where no pulses occur will distort the result. Therefore, time intervals without pulses are identified, referred to as *gaps*.The time intervals that contain pulses are also identified, referred to as *sections*. Interpolation is then performed only on the sections, whereas the gaps are ignored for the spectrum calculation.

A *gap threshold* ensures that pulses with large intervals are not split into multiple sections, while a *section threshold* ensures that singular pulses within a long gap are not included in calculation.

Example: Non-contiguous pulse measurement

A typical measurement setup that results in non-contiguous pulses is a rotating radar antenna scanning the air. For most of the time required for a single rotation, no pulses will be received. However, when an object comes within the scan area, several pulses will be detected within a short duration in time (this will be identified as a section). When the object leaves the scan area again, the pulses will stop, defining a gap until the next object is detected.

Blocks

Spectrum calculation is then performed for the individual sections only. However, the Fourier transformation is not performed on the entire section in one step. Each section is split into blocks, which may overlap. An FFT is performed on each block to calculate an individual result. The smaller the block size, the more individual results are calculated, and the more precise the final result. Thus, the block size determines the resolution bandwidth in the final spectrum. Note that while the block size may be defined manually, the RBW cannot.

Window functions

Each block with its measured and interpolated values is multiplied with a specific window function. Windowing helps minimize the discontinuities at the end of the measured signal interval and thus reduces the effect of spectral leakage, increasing the frequency resolution.

Various different window functions are provided in the R&S VSE Pulse application. Each of the window functions has specific characteristics, including some advantages and some trade-offs. These characteristics need to be considered carefully to find the optimum solution for the measurement task.

Table 4-1: FFT window functions

Window type	Function
Rectangular	The regtangular window function is in effect not a function at all, it maintains the original sampled data. This may be useful to minimize the required bandwidth; however, heavy sidelobes may occur, which do not exist in the original signal.
Hamming	$w_{hamming}(n) = 0.54 - 0.46(\frac{2\pi n}{length - 1})$
Hann	$w_{hann}(n) = 0.5 - 0.5(\frac{2\pi n}{length - 1})$

Window type	Function
Blackman (default)	$w_{blackman}(n) = \frac{alpha+1}{2} - 0.5cos\left(\frac{2\pi n}{length-1}\right) - \frac{alpha}{2}cos\left(\frac{4\pi n}{length-1}\right)$ with alpha = $\frac{0.5}{1+cos\frac{2\pi}{len-1}}$
Bartlett	$w_{bartlett}(n) = 0.54 - 0.46\left(\frac{2\pi n}{length-1}\right)$

Averaging and final spectrum

After windowing, an FFT is performed on each block, and the individual spectrum results are then combined to a total result by averaging the traces. The complete process to calculate a parameter spectrum is shown in figure 4-4.

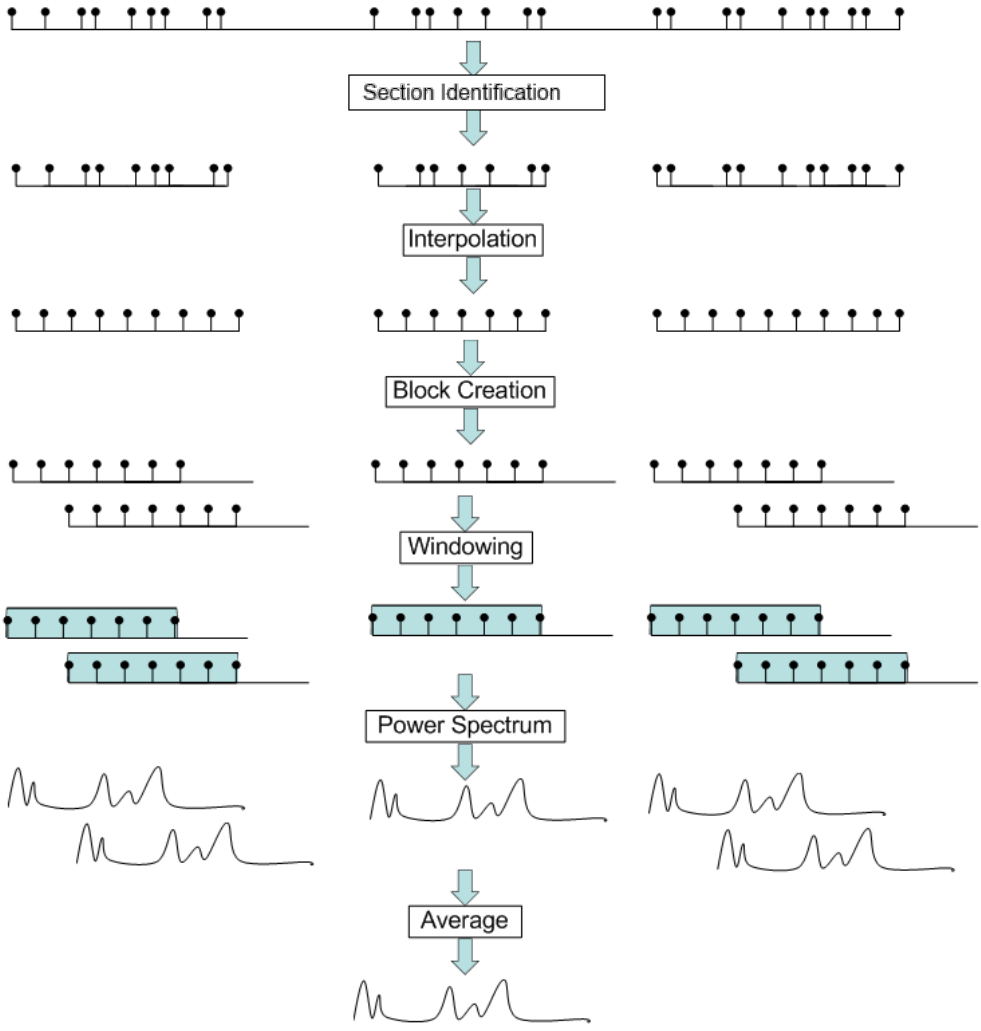


Fig. 4-4: Calculating a parameter spectrum for non-contiguous pulses

4.4 Receiving Data Input and Providing Data Output

The R&S VSE can analyze signals from different input sources and provide various types of output (such as noise or trigger signals).

4.4.1 Input from Noise Sources

The instrument in use may provide a connector (NOISE SOURCE CONTROL) with a voltage supply for an external noise source. By switching the supply voltage for an external noise source on or off via the software, you can activate or deactive the connected device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the instrument in use itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the instrument in use and measure the total noise power. From this value you can determine the noise power of the instrument in use. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

The noise source is controlled in the "Output" settings, see "Noise Source" on page 50

4.4.2 Receiving and Providing Trigger Signals

Using one of the TRIGGER INPUT / OUTPUT connectors of the instrument in use, the R&S VSE can use a signal from an external reference as a trigger to capture data. Alternatively, the internal trigger signal used by the instrument in use can be output for use by other connected devices. Using the same trigger on several devices is useful to synchronize the transmitted and received signals within a measurement.

For details on the connectors see the R&S VSE "Getting Started" manual.

External trigger as input

If the trigger signal for the R&S VSE is provided by an external reference, the reference signal source must be connected to the instrument in use and the trigger source must be defined as "External" for the R&S VSE.

Trigger output

The instrument in use can provide output to another device either to pass on the internal trigger signal, or to indicate that the instrument in use itself is ready to trigger.

The trigger signal can be output by the instrument in use automatically, or manually by the user. If it is provided automatically, a high signal is output when the instrument in use has triggered due to a measurement start ("Device Triggered"), or when the instrument in use is ready to receive a trigger signal after a measurement start ("Trigger Armed").

Manual triggering

If the trigger output signal is initiated manually, the length and level (high/low) of the trigger pulse is also user-definable. Note, however, that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is provided.

Providing trigger signals as output is described in detail in the R&S VSE User Manual.

4.5 Trace Evaluation

Traces in graphical result displays based on the defined result range (see chapter 6.1.2, "Result Range", on page 72) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

You can configure up to 6 individual traces for the following result displays (see chapter 6.1.2, "Result Range", on page 72):

- "Pulse Frequency" on page 25
- "Pulse Magnitude" on page 25
- "Pulse Phase" on page 26
- "Pulse Phase (Wrapped)" on page 27
- Trace Statistics.....41

4.5.1 Trace Statistics

Each trace represents an analysis of the data measured in one result range. Statistical evaluations can be performed over several traces, that is, result ranges. Which ranges and how many are evaluated depends on the configuration settings.

Selected pulse vs all pulses

The Capture / Average Count determines how many measurements are evaluated.

For each measurement, in turn, either the selected pulse only (that is: one result range), or all detected pulses (that is: possibly several result ranges) can be included in the statistical evaluation.

Thus, the overall number of averaging steps depends on the Capture / Average Count and the statistical evaluation mode.

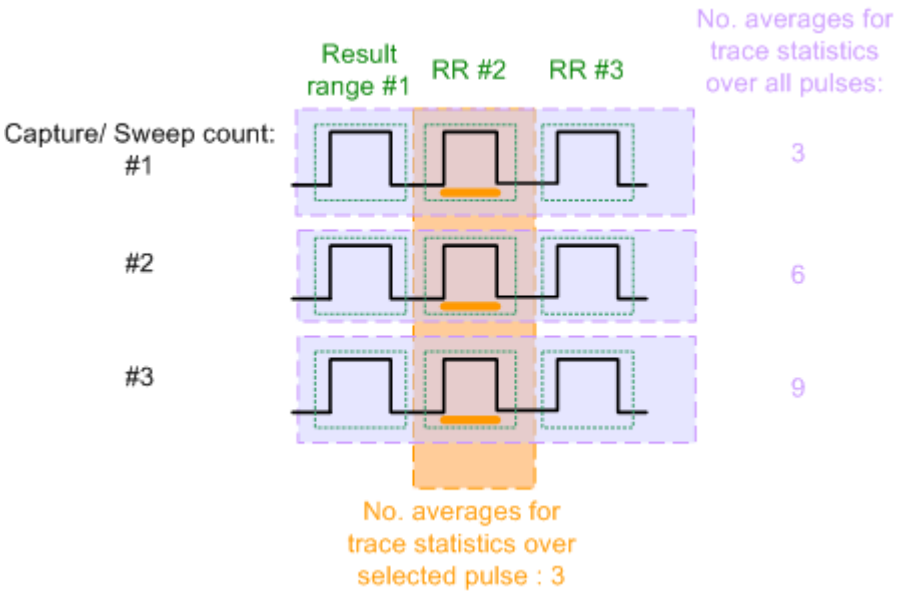


Fig. 4-5: Trace statistics - number of averaging steps

5 Configuration

Pulse measurements require a special application on the R&S VSE.

General R&S VSE functions

The application-independent functions for general tasks on the R&S VSE are also available for Pulse measurements and are described in the R&S VSE Base Software User Manual. In particular, this comprises the following functionality:

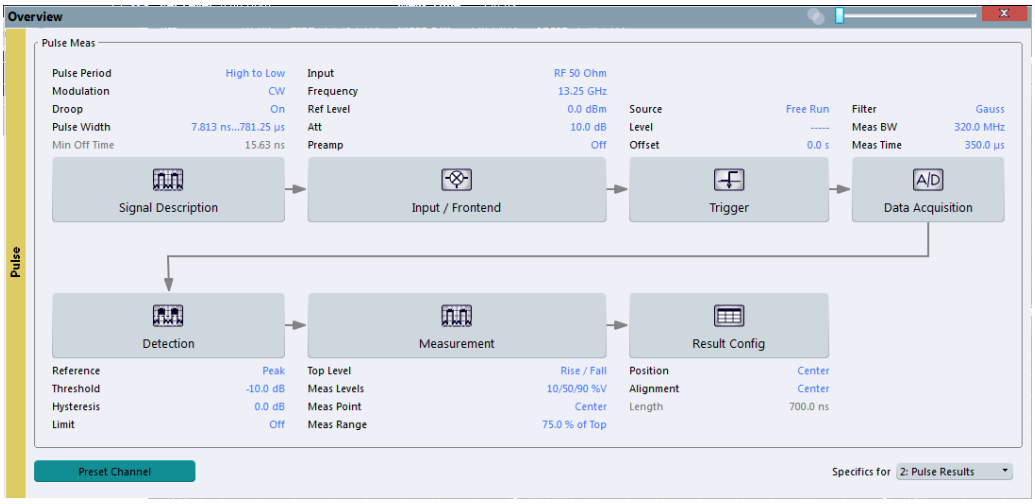
- Controlling Instruments and Capturing I/Q Data
- Data Management
- General Software Preferences and Information

- Configuration Overview....43
- Signal Description....45
- Input and Output Settings....47
- Frontend Settings....52
- Trigger Settings....56
- Data Acquisition....61
- Pulse Detection....62
- Pulse Measurement Settings....64
- Automatic Settings....69

5.1 Configuration Overview

Throughout the measurement configuration, an overview of the most important currently defined settings is provided in the "Overview".

The "Overview" is displayed when you select the "Overview" icon in the main toolbar, or the "Meas Setup > Overview" menu item.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire measurement channel from input over processing to output and evaluation by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Signal Description
   See chapter 5.2, "Signal Description", on page 45
2. Input and Frontend Settings
   See chapter 5.3, "Input and Output Settings", on page 47
3. (Optionally:) Trigger/Gate
   See chapter 5.5, "Trigger Settings", on page 56
4. Data Acquisition
   See chapter 5.6, "Data Acquisition", on page 61
5. Pulse Detection
   See chapter 5.7, "Pulse Detection", on page 62
6. Pulse Measurement
   See chapter 5.8, "Pulse Measurement Settings", on page 64
7. Result Configuration
   See chapter 6.1, "Result Configuration", on page 71

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

Preset Channel..... 44
Specifics for.....44

Preset Channel
Select the "Preset Channel" button in the lower lefthand corner of the "Overview" to restore all measurement settings **in the current channel** to their default values.

Remote command:
`SYSTem:PRESet:CHANnel[:EXECute]` on page 108

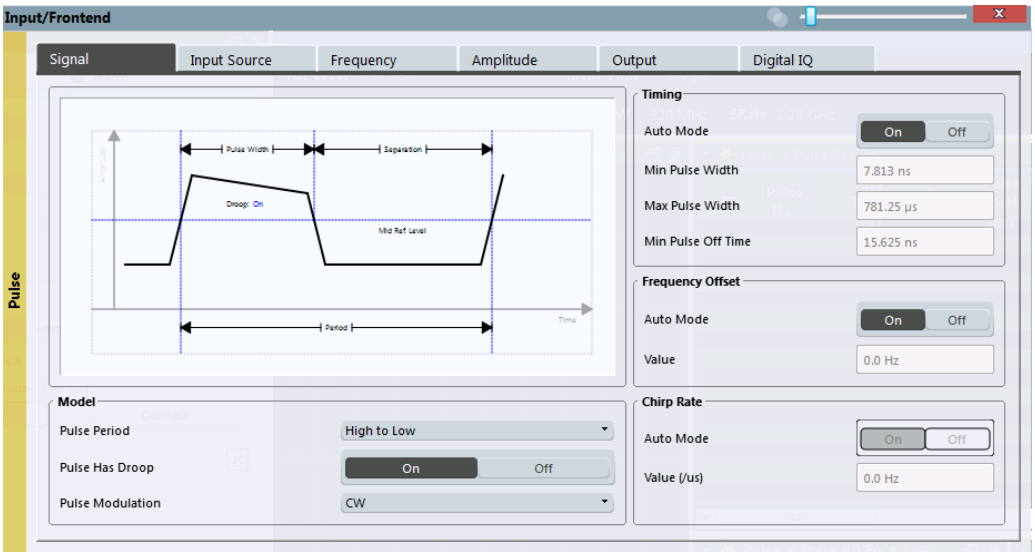
Specifics for
The measurement channel may contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specifics for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

5.2 Signal Description

The signal description provides information on the expected input signal, which optimizes pulse detection and measurement.



Pulse Period....45
Pulse Has Droop....45
Pulse Modulation....46
Timing Auto Mode....46
Minimum Pulse Width, Maximum Pulse Width....46
Min Pulse Off Time....46
Frequency Offset Auto Mode....46
Frequency Offset Value....46
Chirp Rate Auto Mode....47
Chirp Rate....47

Pulse Period
Defines how a pulse is detected.

"High to Low" The pulse period begins with the falling edge of the preceeding pulse and ends with the falling edge of the current pulse.

"Low to High" The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod` on page 111

Pulse Has Droop
If enabled, a pulse can be modeled as having amplitude droop, i.e. the pulse top may not be flat.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop` on page 110

Pulse Modulation
Defines the expected pulse modulation:

"Arbitrary"	Modulation not considered (no phase error/frequency error results available)
"CW"	Continuous wave modulation, i.e. only the carrier power is modulated (On/Off) For CW modulation, additional parameters are available to define the frequency offset.
"Linear FM"	Linear frequency modulation (FM) (The frequency changes linearly over time within each pulse) For linear pulse modulation, additional parameters are available to define the chirp rate.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation` on page 111

Timing Auto Mode
If enabled, the timing parameters (minimum pulse width, maximum pulse width, minimum pulse off time) are determined automatically from the current capture settings.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:AUTO` on page 109

Minimum Pulse Width, Maximum Pulse Width
Defines a minimum and maximum pulse width; pulses outside this range are not detected. The available value range is restricted by the sample rate.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:MAX` on page 109
`SENSe:TRACe:MEASurement:DEFine:DURation:MIN` on page 109

Min Pulse Off Time
The minimum time the pulse is "off", i.e. the time between successive pulses. This value is used to determine noise statistics and to reject short drops in amplitude during pulse "on" time. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:DURation:OFF` on page 109

Frequency Offset Auto Mode
If enabled, the frequency offset is estimated automatically for each individual pulse.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO` on page 110

Frequency Offset Value
Defines a known frequency offset to be corrected in the pulse acquisition data.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet` on page 109

Chirp Rate Auto Mode
If enabled, the chirp rate is estimated automatically for each individual pulse.

Remote command:
SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO on page 110

Chirp Rate
Defines a known frequency chirp rate (in Hz/µs) to be used to generate an ideal pulse waveform for computing frequency and phase error parameters. This value is assumed constant for all measured pulses.

Remote command:
SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE on page 110

5.3 Input and Output Settings

The R&S VSE can analyze signals from different input sources and provide various types of output (such as noise or trigger signals). The settings for data input and output are described here.

- Input Source Settings....47
- Output Settings....50

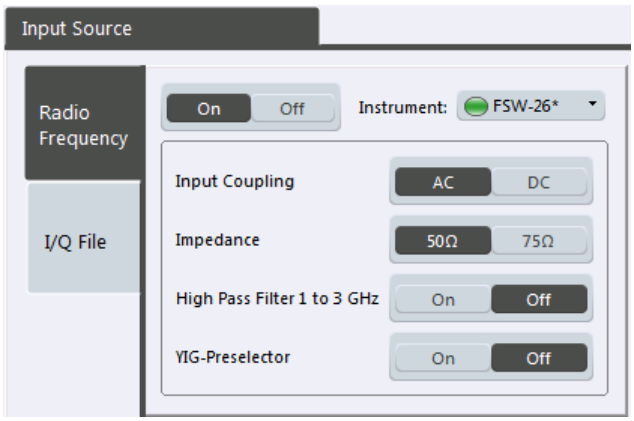
5.3.1 Input Source Settings

The R&S VSE can control the input sources of the connected instruments.

- Radio Frequency Input....47
- I/Q File Input....49

5.3.1.1 Radio Frequency Input

The default input source for the instrument in use is "Radio Frequency".



Radio Frequency State 48
Instrument 48
Input Coupling 48
Impedance 48
High-Pass Filter 1...3 GHz 48
YIG-Preselector 48

Radio Frequency State
Activates input from the RF INPUT connector.

Remote command:
`INPut:SELect` on page 113

Instrument
Specifies a configured instrument to be used for input.

Input Coupling
The RF input of the instrument in use can be coupled by alternating current (AC) or direct current (DC).

AC coupling blocks any DC voltage from the input signal. This is the default setting to prevent damage to the instrument. Very low frequencies in the input signal may be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the data sheet.

Remote command:
`INPut:COUPling` on page 112

Impedance
For some measurements, the reference impedance for the measured levels of the instrument in use can be set to 50 Ω or 75 Ω.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Remote command:
`INPut:IMPedance` on page 113

High-Pass Filter 1...3 GHz
Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the analyzer in order to measure the harmonics for a DUT, for example.

This function may require an additional hardware option on the instrument in use.

Remote command:
`INPut:FILTer:HPASs[:STATe]` on page 112

YIG-Preselector
Activates or deactivates the YIG-preselector, if available on the instrument in use.

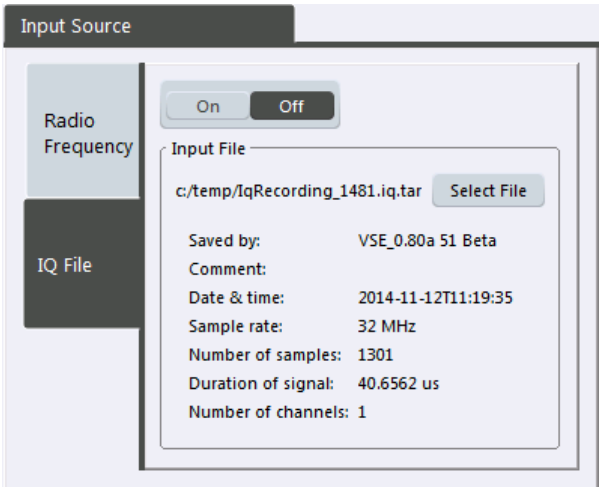
An internal YIG-preselector at the input of the instrument in use ensures that image frequencies are rejected. However, this is only possible for a restricted bandwidth. In order to use the maximum bandwidth for signal analysis you can deactivate the YIG-preselector at the input of the instrument in use, which may lead to image-frequency display.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 112

5.3.1.2 I/Q File Input

Alternatively to "live" data input from a connected instrument, measurement data to be analyzed by the R&S VSE software can also be provided "offline" by a stored data file. This allows you to perform a measurement on any instrument, store the results to a file, and analyze the stored data partially or as a whole at any time using the R&S VSE software.

The "Input Source" settings defined in the "Input" dialog box are identical to those configured for a specific channel in the "Measurement Group Setup" window.



I/Q File State 49
Input File 49

I/Q File State
Activates input from the selected I/Q data file.

Remote command:
`INPut:SELect` on page 113

Input File
Specifies the I/Q data file to be used for input.

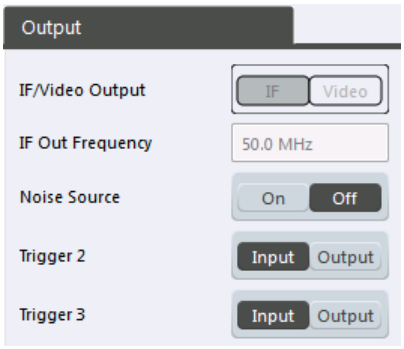
Select "Select File" to open the "Load I/Q File" dialog box.

5.3.2 Output Settings

The R&S VSE can control the output provided by the instrument in use to special connectors for other devices.

For details on the output connectors refer to the instrument's Getting Started manual.

Output settings can be configured via the "Input & Output > Output" menu item. Which output settings and connectors are available depends on the instrument in use.



IF/VIDEO/DEMOD Output....50
IF Out Frequency....50
Noise Source....50
Trigger 2/3....50
└ Output Type....51
└ Level....51
└ Pulse Length....51
└ Send Trigger....51

IF/VIDEO/DEMOD Output
This function is currently not available.

IF Out Frequency
This function is currently not available.

Noise Source
Switches the supply voltage for an external noise source on the instrument in use on or off, if available.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the instrument in use itself, for example when measuring the noise level of a DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 114

Trigger 2/3
Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

"Input" The signal at the connector is used as an external trigger source by the instrument in use. No further trigger parameters are available for the connector.

"Output" The instrument in use sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 125
`OUTPut:TRIGger<port>:DIRection` on page 125

Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the instrument in use triggers.

"Trigger Armed" Sends a (high level) trigger when the instrument in use is in "Ready for trigger" state.
This state is indicated by a status bit in the `STATus:OPERation` register (bit 5), as well as by a low level signal at the AUX port (pin 9) of the instrument in use, if available.

"User Defined" Sends a trigger when user selects "Send Trigger" button.
In this case, further parameters are available for the output signal.

Remote command:
`OUTPut:TRIGger<port>:OTYPe` on page 125

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:
`OUTPut:TRIGger<port>:LEVel` on page 125

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 126

Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 126

5.4 Frontend Settings

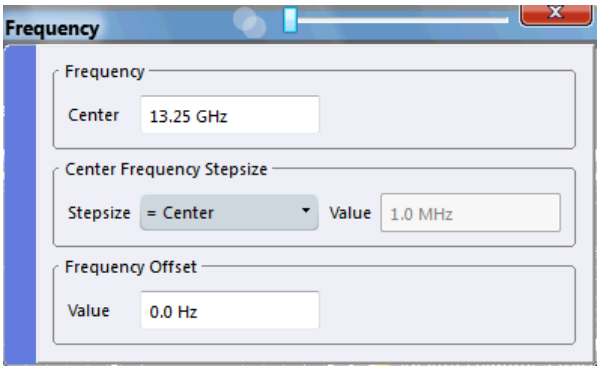
The frequency and amplitude settings represent the "frontend" of the measurement setup.

- Frequency Settings 52
- Amplitude Settings 53

5.4.1 Frequency Settings

Frequency settings can be configured via the "Frequency" dialog box, which is displayed when you do one of the following:

- Select the "Input & Output > Frequency" menu item.
- Select the "Frequency" tab in the "Input/Frontend Settings" dialog box.



Center frequency 52
Center Frequency Stepsize 53
Frequency Offset 53

Center frequency
Defines the normal center frequency of the signal.

$0\ Hz \le f_{center} \le f_{max}$

f_{max} and $span_{min}$ depend on the instrument and are specified in the data sheet.

Note: For file input you can shift the center frequency of the current measurement compared to the stored measurement data. The maximum shift depends on the channel's current analysis bandwidth.

$$CFshift_{max} = CF_{file} \pm \frac{ABW_{file} - ABW_{channel}}{2}$$

If the file does not provide the center frequency, it is assumed to be 0 Hz.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 114

Center Frequency Stepsize
Defines the step size by which the center frequency is increased or decreased using the arrow keys.

When you use the mouse wheel, the center frequency changes in steps of only 1/10 of the "Center Frequency Stepsize".

The step size can be coupled to another value or it can be manually set to a fixed value.

"= Center" Sets the step size to the value of the center frequency. The used value is indicated in the "Value" field.

"Manual" Defines a fixed step size for the center frequency. Enter the step size in the "Value" field.

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 115

Frequency Offset
Shifts the displayed frequency range along the x-axis by the defined offset.

This parameter has no effect on the instrument's hardware, or on the captured data or on data processing. It is simply a manipulation of the final results in which absolute frequency values are displayed. Thus, the x-axis of a spectrum display is shifted by a constant offset if it shows absolute frequencies, but not if it shows frequencies relative to the signal's center frequency.

A frequency offset can be used to correct the display of a signal that is slightly distorted by the measurement setup, for example.

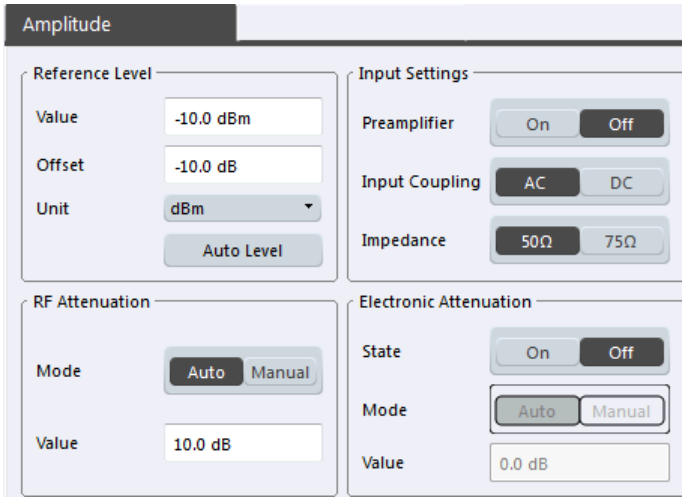
The allowed values range from -100 GHz to 100 GHz. The default setting is 0 Hz.

Remote command:
`[SENSe:]FREQuency:OFFSet` on page 115

5.4.2 Amplitude Settings

Amplitude settings affect the y-axis values.

Amplitude settings are available via the "Input & Output > Amplitude" menu item. Note that the availability of these settings depends on the instrument in use.



Reference Level 54
└ Shifting the Display (Offset) 54
RF Attenuation 55
└ Attenuation Mode / Value 55
Using Electronic Attenuation 55
Input Settings 56
└ Preamplifier 56

Reference Level
Defines the expected maximum reference level. Signal levels above this value may not be measured correctly, which is indicated by the "IF OVLD" status display.

The reference level is also used to scale power diagrams; the reference level is then used as the maximum on the y-axis.

Since the hardware of the instrument in use is adapted according to this value, it is recommended that you set the reference level close above the expected maximum signal level to ensure an optimum measurement (no compression, good signal-to-noise ratio).

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 116

Shifting the Display (Offset) ← Reference Level
Defines an arithmetic level offset. This offset is added to the measured level. The scaling of the y-axis is changed accordingly.

Define an offset if the signal is attenuated or amplified before it is fed into the R&S VSE so the application shows correct power results. All displayed power level results will be shifted by this value.

The setting range is ±200 dB in 0.01 dB steps.

Note, however, that the *internal* reference level (used to adjust the hardware settings to the expected signal optimally) ignores any "Reference Level Offset". Thus, it is important to keep in mind the actual power level the R&S VSE must handle, and not to rely on the displayed reference level (internal reference level = displayed reference level - offset).

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet` on page 116

RF Attenuation
Defines the mechanical attenuation for RF input.

Attenuation Mode / Value ← RF Attenuation
The RF attenuation can be set automatically as a function of the selected reference level (Auto mode). This ensures that the optimum RF attenuation is always used. It is the default setting.

In "Manual" mode, you can set the RF attenuation in 1 dB steps (down to 0 dB). Other entries are rounded to the next integer value. The range is specified in the data sheet. If the defined reference level cannot be set for the defined RF attenuation, the reference level is adjusted accordingly and the warning "Limit reached" is displayed.

NOTICE! Risk of hardware damage due to high power levels. When decreasing the attenuation manually, ensure that the power level does not exceed the maximum level allowed at the RF input, as an overload may lead to hardware damage.

Remote command:
`INPut:ATTenuation` on page 117
`INPut:ATTenuation:AUTO` on page 118

Using Electronic Attenuation
If the (optional) Electronic Attenuation hardware is installed on the instrument in use, you can also activate an electronic attenuator.

In "Auto" mode, the settings are defined automatically; in "Manual" mode, you can define the mechanical and electronic attenuation separately.

Note: Note that restrictions may apply concerning which frequencies electronic attenuation is available for, depending on which instrument is connected to the R&S VSE software. Check your instrument documentation for details.
In "Auto" mode, RF attenuation is provided by the electronic attenuator as much as possible to reduce the amount of mechanical switching required. Mechanical attenuation may provide a better signal-to-noise ratio, however.

When you switch off electronic attenuation, the RF attenuation is automatically set to the same mode (auto/manual) as the electronic attenuation was set to. Thus, the RF attenuation may be set to automatic mode, and the full attenuation is provided by the mechanical attenuator, if possible.

If the defined reference level cannot be set for the given attenuation, the reference level is adjusted accordingly and the warning "Limit reached" is displayed in the status bar.

Remote command:
`INPut:EATT:STATe` on page 119
`INPut:EATT:AUTO` on page 118
`INPut:EATT` on page 118

Input Settings
Some input settings affect the measured amplitude of the signal, as well.

For details see chapter 5.3.1.1, "Radio Frequency Input", on page 47.

Preamplifier ← Input Settings
If the (optional) Preamplifier hardware is installed on the instrument in use, a preamplifier can be activated for the RF input signal.

You can use a preamplifier to analyze signals from DUTs with low input power.

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

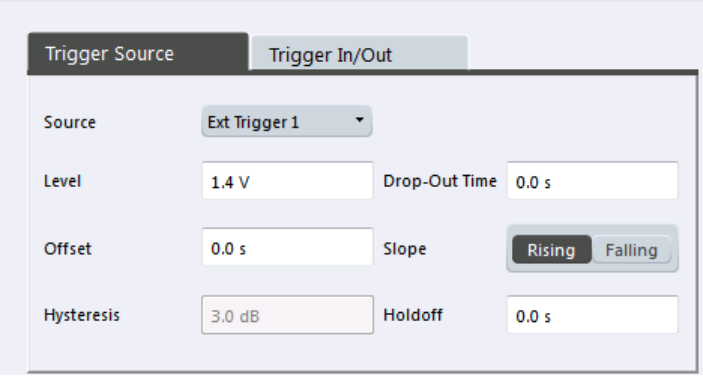
Remote command:
`INPut:GAIN:STATe` on page 116
`INPut:GAIN[:VALue]` on page 117

5.5 Trigger Settings

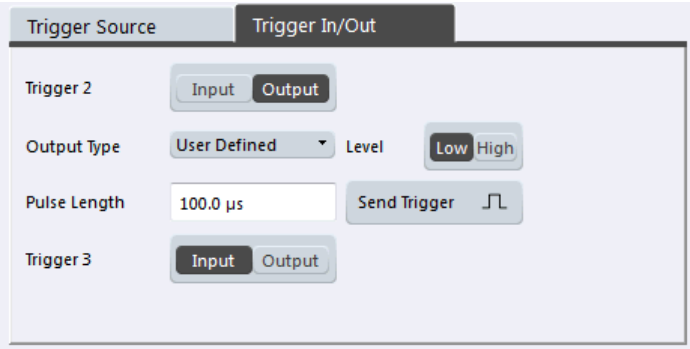
Trigger settings determine when the input signal is measured.

Trigger settings can be configured in the "Trigger and Gate" dialog box, which is displayed when you do one of the following:

- Select the "Trigger" button in the "Overview".
- From the "Input & Output" menu, select "Trigger".



External triggers from one of the TRIGGER INPUT/OUTPUT connectors on the R&S VSE are configured in a separate tab of the dialog box.



Trigger Settings....57
└ Trigger Source....57
└ Free Run....57
└ External Trigger<X>....58
└ I/Q Power....58
└ IF Power....58
└ RF Power....58
└ Trigger Level....58
└ Repetition Interval....59
└ Drop-Out Time....59
└ Trigger Offset....59
└ Slope....59
└ Hysteresis....59
└ Trigger Holdoff....60
Trigger 2/3....60
└ Output Type....60
└ Level....60
└ Pulse Length....61
└ Send Trigger....61

Trigger Settings
The trigger settings define the beginning of a measurement.

Trigger Source ← Trigger Settings
Defines the trigger source. If a trigger source other than "Free Run" is set, "TRG" is displayed in the channel bar and the trigger source is indicated.

Note: When triggering is activated, the squelch function is automatically disabled.

Remote command:
`TRIGger[:SEQuence]:SOURce` on page 123

Free Run ← Trigger Source ← Trigger Settings
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitely.

Remote command:
`TRIG:SOUR IMM`, see `TRIGger[:SEQuence]:SOURce` on page 123

External Trigger<X> ← Trigger Source ← Trigger Settings
Data acquisition starts when the signal fed into the specified input connector or input channel of the instrument in use meets or exceeds the specified trigger level.

(See "Trigger Level" on page 58).

Note: Which input and output connectors are available depends on the connected instrument. For details see the "Instrument Tour" chapter in the instrument's Getting Started manual.

Remote command:
`TRIG:SOUR EXT`, `TRIG:SOUR EXT2`, `TRIG:SOUR EXT3`, `TRIG:SOUR EXT4`
See `TRIGger[:SEQuence]:SOURce` on page 123

I/Q Power ← Trigger Source ← Trigger Settings
Triggers the measurement when the magnitude of the sampled I/Q data exceeds the trigger threshold.

Remote command:
`TRIG:SOUR IQP`, see `TRIGger[:SEQuence]:SOURce` on page 123

IF Power ← Trigger Source ← Trigger Settings
The R&S VSE starts capturing data as soon as the trigger level is exceeded around the third intermediate frequency.

(The third IF represents the center frequency.)

This trigger source is only available for RF input.

The available trigger levels depend on the RF attenuation and preamplification. A reference level offset, if defined, is also considered.

For details on available trigger levels and trigger bandwidths see the data sheet.

Remote command:
`TRIG:SOUR IFP`, see `TRIGger[:SEQuence]:SOURce` on page 123

RF Power ← Trigger Source ← Trigger Settings
Defines triggering of the measurement via signals which are outside the displayed measurement range.

For this purpose the software uses a level detector at the first intermediate frequency.

The resulting trigger level at the RF input depends on the RF attenuation and preamplification. For details on available trigger levels see the instrument's data sheet.

Note: If the input signal contains frequencies outside of this range (e.g. for fullspan measurements), the measurement may be aborted and a message indicating the allowed input frequencies is displayed in the status bar.

A "Trigger Offset", "Trigger Polarity" and "Trigger Holdoff" (to improve the trigger stability) can be defined for the RF trigger, but no "Hysteresis".

Remote command:
`TRIG:SOUR RFP`, see `TRIGger[:SEQuence]:SOURce` on page 123

Trigger Level ← Trigger Settings
Defines the trigger level for the specified trigger source.

For details on supported trigger levels, see the data sheet.

Remote command:
TRIGger[:SEQuence]:LEVel:IFPower on page 121
TRIGger[:SEQuence]:LEVel:IQPower on page 122
TRIGger[:SEQuence]:LEVel[:EXTernal<port>] on page 121
TRIGger[:SEQuence]:LEVel:RFPower on page 123

Repetition Interval ← Trigger Settings
Defines the repetition interval for a time trigger. The shortest interval is 2 ms.

The repetition interval should be set to the exact pulse period, burst length, frame length or other repetitive signal characteristic.

Remote command:
TRIGger[:SEQuence]:TIME:RINTerval on page 124

Drop-Out Time ← Trigger Settings
Defines the time the input signal must stay below the trigger level before triggering again.

Remote command:
TRIGger[:SEQuence]:DTIMe on page 120

Trigger Offset ← Trigger Settings
Defines the time offset between the trigger event and the start of the measurement.

offset > 0:	Start of the measurement is delayed
offset < 0:	Measurement starts earlier (pre-trigger) Only possible for zero span (e.g. I/Q Analyzer application) and gated trigger switched off Maximum allowed range limited by the measurement time: $pretrigger_{max}$ = $measurement\ time_{max}$

(If supported by the instrument in use.)

Remote command:
TRIGger[:SEQuence]:HOLDoff[:TIME] on page 120

Slope ← Trigger Settings
For all trigger sources except time you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Remote command:
TRIGger[:SEQuence]:SLOPe on page 123

Hysteresis ← Trigger Settings
Defines the distance in dB to the trigger level that the trigger source must exceed before a trigger event occurs. Settting a hysteresis avoids unwanted trigger events caused by noise oscillation around the trigger level.

This setting is only available for "IF Power" or "Magnitude (offline)" trigger sources. The range of the value depends on the instrument in use.

Remote command:
TRIGger[:SEQuence]:IFPower:HYSTeresis on page 121
TRIGger[:SEQuence]:MAPower:HYSTeresis on page 122

Trigger Holdoff ← Trigger Settings
Defines the minimum time (in seconds) that must pass between two trigger events. Trigger events that occur during the holdoff time are ignored.

Remote command:
TRIGger[:SEQuence]:IFPower:HOLDoff on page 120
TRIGger[:SEQuence]:MAPower:HOLDoff on page 122

Trigger 2/3
Defines the usage of variable trigger input/output connectors on the instrument in use. Which output settings are available depends on the type of instrument in use. For details see the instrument's documentation.

"Input" The signal at the connector is used as an external trigger source by the instrument in use. No further trigger parameters are available for the connector.

"Output" The instrument in use sends a trigger signal to the output connector to be used by connected devices.
Further trigger parameters are available for the connector.

Remote command:
OUTPut:TRIGger<port>:LEVel on page 125
OUTPut:TRIGger<port>:DIRection on page 125

Output Type ← Trigger 2/3
Type of signal to be sent to the output

"Device Triggered" (Default) Sends a trigger when the instrument in use triggers.

"Trigger Armed" Sends a (high level) trigger when the instrument in use is in "Ready for trigger" state.
This state is indicated by a status bit in the STATus:OPERation register (bit 5), as well as by a low level signal at the AUX port (pin 9) of the instrument in use, if available.

"User Defined" Sends a trigger when user selects "Send Trigger" button.
In this case, further parameters are available for the output signal.

Remote command:
OUTPut:TRIGger<port>:OTYPe on page 125

Level ← Output Type ← Trigger 2/3
Defines whether a constant high (1) or low (0) signal is sent to the output connector.

Remote command:
OUTPut:TRIGger<port>:LEVel on page 125

Pulse Length ← Output Type ← Trigger 2/3
Defines the length of the pulse sent as a trigger to the output connector.

Remote command:
`OUTPut:TRIGger<port>:PULSe:LENGth` on page 126

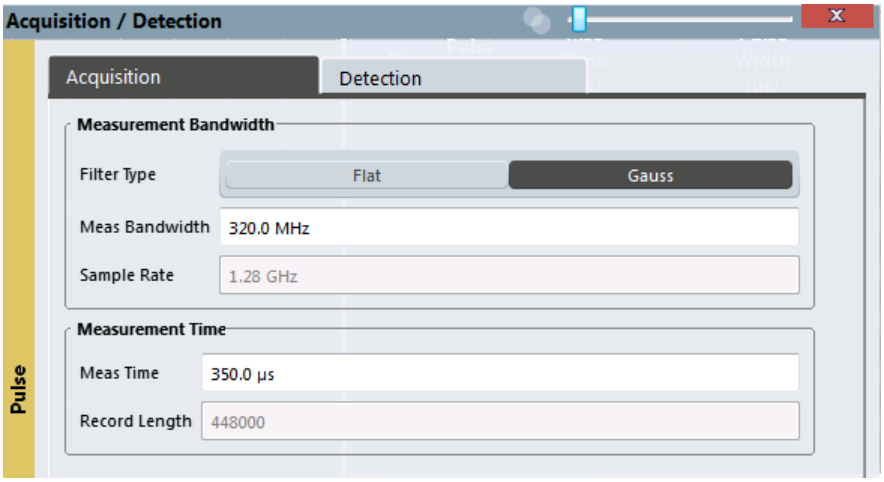
Send Trigger ← Output Type ← Trigger 2/3
Sends a user-defined trigger to the output connector immediately. Note that the trigger pulse level is always opposite to the constant signal level defined by the output "Level" setting, e.g. for "Level = High", a constant high signal is output to the connector until the "Send Trigger" button is selected. Then, a low pulse is sent.

Which pulse level will be sent is indicated by a graphic on the button.

Remote command:
`OUTPut:TRIGger<port>:PULSe:IMMediate` on page 126

5.6 Data Acquisition

You must define how much and how data is captured from the input signal.



The settings in this dialog box are available when you do one of the following:

- Select the "Data Acquisition" button from the "Overview".
- From the "Meas Setup" menu, select "Data Acquisition".

Filter type 61
Measurement Bandwidth 62
Sample rate 62
Measurement Time 62
Record length 62

Filter type
Defines the filter to be used for demodulation.

"Flat" Standard flat demodulation filter

"Gauss" Filter with optimized settling behaviour (default)

Note: For Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.
For details see chapter A.4, "Effects of Large Gauss Filters", on page 262.

Remote command:
`[SENSe:]BANDwidth|BWIDth:DEMod:TYPE` on page 127

Measurement Bandwidth
The measurement bandwidth is defined by the used filter and the sample rate. Either a flat or a Gauss filter are available. For information on supported sample rates and filter bandwidths see the data sheet.

Remote command:
`[SENSe:]BANDwidth:DEMod` on page 127

Sample rate
The sample rate for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

Measurement Time
Defines how long data is captured for analysis ("Meas Time"), or how many samples are captured in each record ("Record Length").

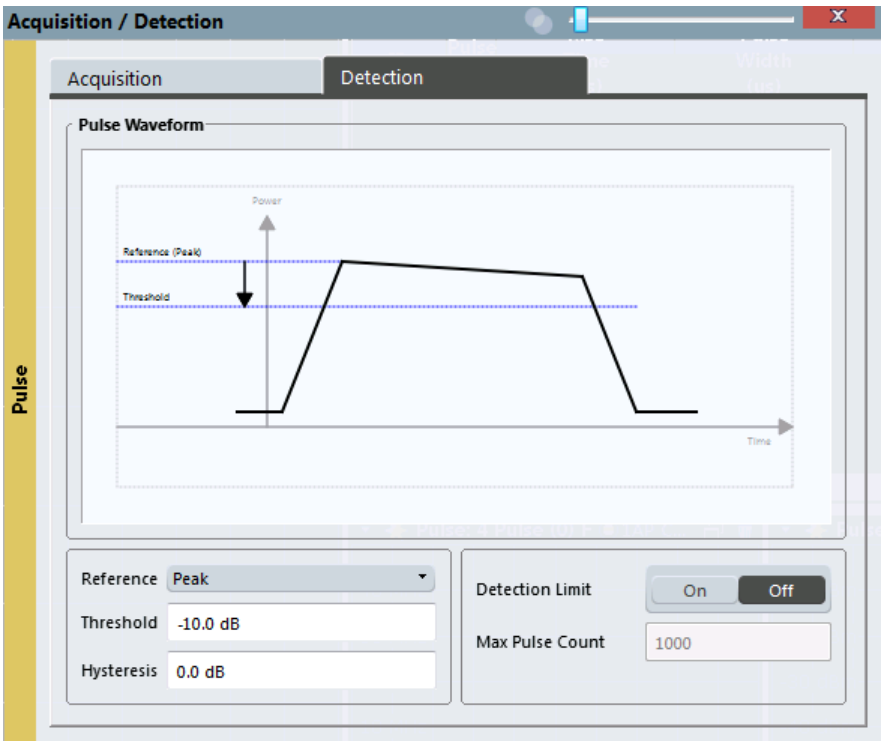
The maximum measurement time in the R&S VSE Pulse application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the R&S VSE.

Remote command:
`[SENSe:]SWEep:TIME` on page 127

Record length
The record length for I/Q data acquisition is indicated for reference only. It is calculated from the defined measurement bandwidth and measurement time, or taken from the I/Q data input file.

5.7 Pulse Detection

The pulse detection settings define the conditions under which a pulse is detected within the input signal.



Reference Source 63
Threshold 63
Hysteresis 64
Detection Limit 64
Maximum Pulse Count 64

Reference Source
Defines the level to be used as a reference for the pulse detection threshold.

"Reference"	Current reference level
"Peak"	Peak level as measured over the entire capture data interval
"Noise"	Noise level determined from the current capture data according to the Min Pulse Off Time parameter set in Signal Description.
"Absolute"	Absolute level defined by the Threshold

Remote command:
`[SENSe:]DETect:REFerence` on page 129

Threshold
The threshold determines whether a pulse is detected or not. The top of a pulse must exceed the threshold in order to be detected. The threshold is defined in dB in relation to the defined reference, or as an absolute threshold in dBm.

Remote command:
`[SENSe:]DETect:THReshold` on page 129

Hysteresis
Defines a hysteresis for pulse detection in dB in relation to the defined threshold. As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Remote command:
`[SENSe:]DETect:HYSTeresis` on page 129

Detection Limit
Restricts the number of pulses to be detected. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

Remote command:
`[SENSe:]DETect:LIMit` on page 128

Maximum Pulse Count
Defines the maximum number of pulses to be detected.

This limit is ignored if Detection Limit is disabled.

Remote command:
`[SENSe:]DETect:LIMit:COUNt` on page 128

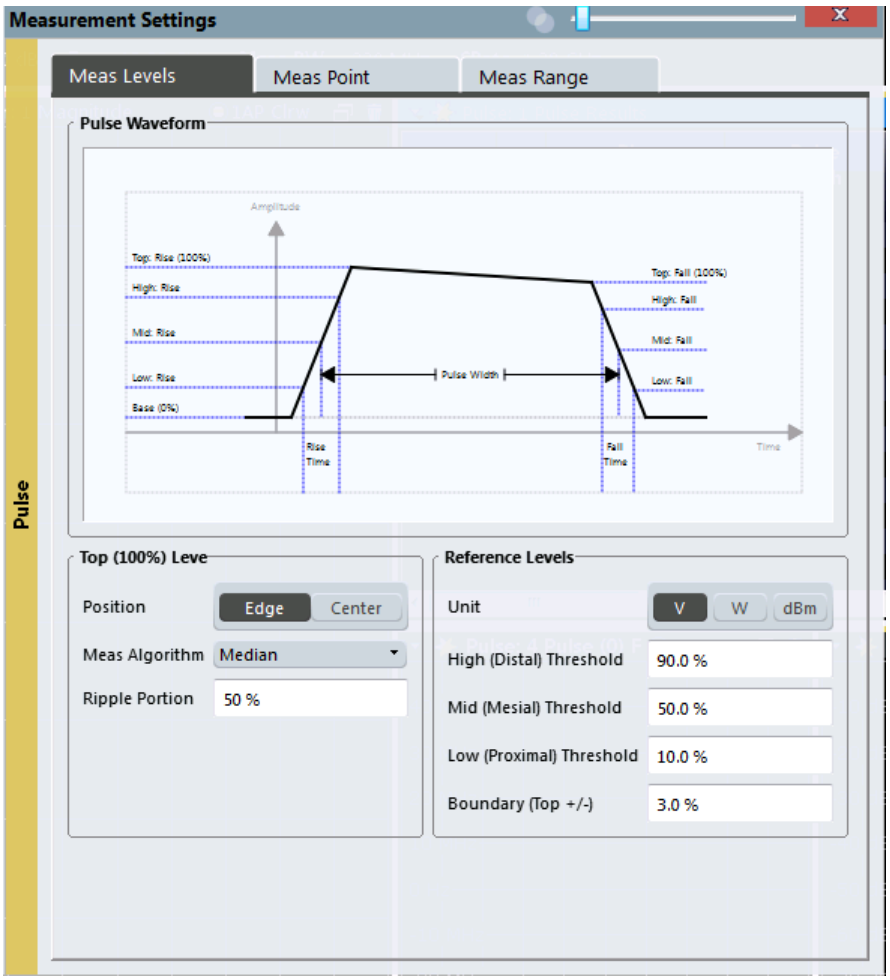
5.8 Pulse Measurement Settings

The pulse measurement settings determine how much data is measured for each pulse, in relation to defined levels, points, or ranges. Which definition is actually used during measurement depends on the selected evaluation method.

- Measurement Levels....64
- Measurement Point....67
- Measurement Range....68

5.8.1 Measurement Levels

Some measurements are performed depending on defined levels.



Position 65
Measurement Algorithm 66
Ripple Portion 66
Reference Level Unit 66
High (Distal) Threshold 66
Mid (Mesial) Threshold 66
Low (Proximal) Threshold 66
Boundary 67

Position

Determines where the 100% value (from base to top) for the rise and fall time measurements is calculated.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

"Edge" The 100% value is measured separately for the rising and falling edges.

"Center" The 100% value is measured at the pulse center and used for all measurements.

Remote command:
SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop on page 131

Measurement Algorithm
Defines the algorithm used to detect the pulse top level.

"Mean" The arithmetic average of the measured values

"Median" The level for which half the values lie above, the other half below in the histogram

"Peak Power" The peak power is used to detect the pulse top level.

Remote command:
SENSe:TRACe:MEASurement:ALGorithm on page 130

Ripple Portion
Defines the portion of the pulse top which is used to measure the ripple.

Remote command:
SENSe:TRACe:MEASurement:DEFine:RIPPle on page 131

Reference Level Unit
Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Remote command:
SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT on page 130

High (Distal) Threshold
The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Remote command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence on page 131

Mid (Mesial) Threshold
The middle threshold in percent of the pulse amplitude used to signify the signify the mid-transition level between pulse states.

Remote command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence on page 132

Low (Proximal) Threshold
The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

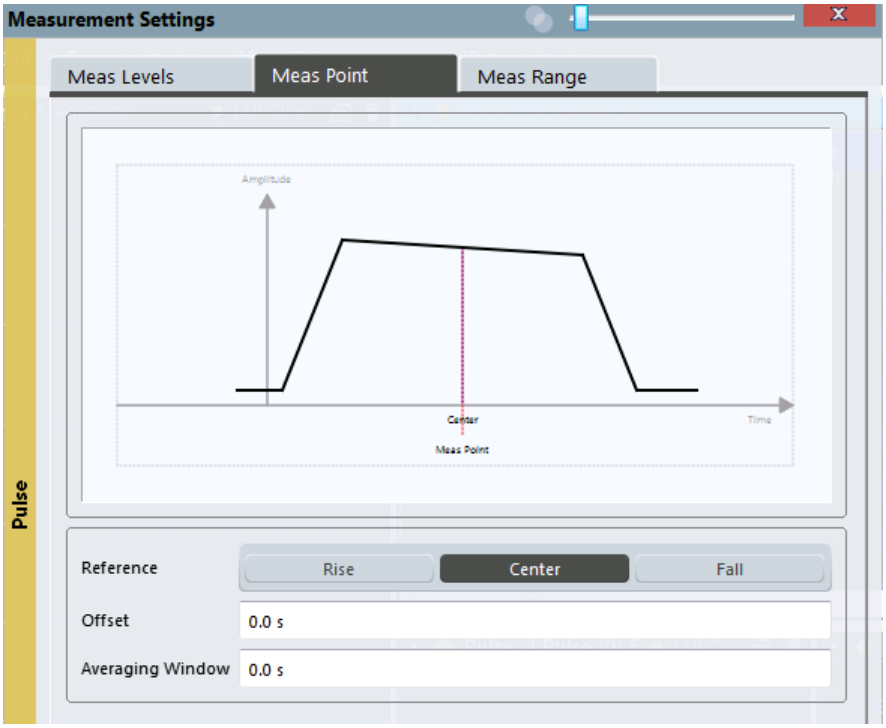
Remote command:
SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence on page 132

Boundary
The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Remote command:
`SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP` on page 130

5.8.2 Measurement Point

Some specific pulse parameters, e.g. the phase or the frequency, are determined at a specific time instant (measurement point) within the pulse. You can configure this point based on a reference and offset value.



Measurement Point Reference 67
Offset 68
Averaging Window 68

Measurement Point Reference
Defines the reference which the Offset refers to.

"Rise" The measurement point is defined in reference to the rising edge (mid-level crossing).

"Center" The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

"Fall" The measurement point is defined in reference to the falling edge (mid-level crossing).

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence on page 133

Offset
The time offset of the measurement point in reference to the pulse center or an edge, depending on the Measurement Point Reference setting.

The "Offset" is indicated in the dialog box.

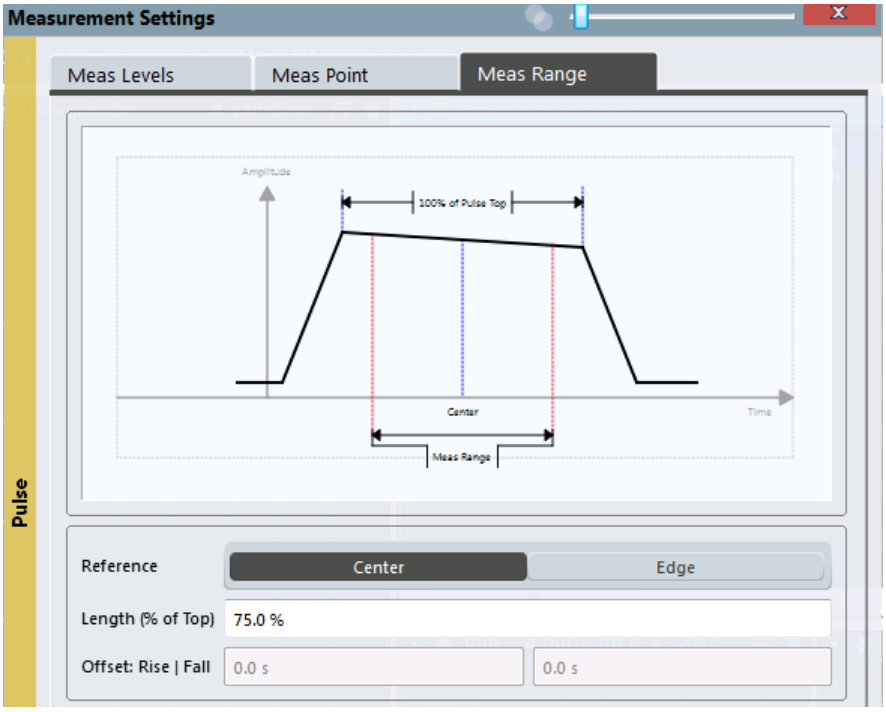
Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant on page 132

Averaging Window
Measurement point results are averaged over a window centered at the measurement point. The length of the averaging window in seconds can be defined. A minimum length of 1 sample is enforced internally.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow on page 132

5.8.3 Measurement Range

Some measurements are performed over a range within the pulse, for example the phase or frequency deviation. The measurement range is specified either by start and end points relative to the rising and falling edges, or as a proportion of the pulse top.



Reference.....69

Reference
Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

"Center" Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

"Edge" Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

Remote command:
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence on page 134
Relative range (Center):
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth on page 133
Absolute range (Edge):
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT on page 133
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt on page 134

5.9 Automatic Settings

Some settings can be adjusted by the R&S VSE automatically according to the current measurement settings.

To activate the automatic adjustment of a setting, select the corresponding function in the AUTO SET toolbar or in the configuration dialog box for the setting, where available.

Auto Scale Continuous (All)..... 69
Auto Scale Once (All)..... 70

Auto Scale Continuous (All)
Automatically determines the optimal result range and reference level position for *each new measurement* in all displayed diagrams (for graphical or pulse-based result displays only).

Remote command:
SENS:TRAC:MEAS:DEF:RRAN:AUTO ON, see SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO on page 145
DISP:TRAC:Y:SCAL:AUTO ON, see DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO on page 190

Auto Scale Once (All)
Automatically determines the optimal result range and reference level position *once* for the *current* measurement settings in all displayed diagrams and pulse-based result displays. All automatic scaling functions are then switched off.

Remote command:
`SENS:TRAC:MEAS:DEF:RRAN:AUTO ONCE`, see `SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO` on page 145
`DISP:TRAC:Y:SCAL:AUTO ONCE`, see `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 190

6 Analysis

After a Pulse measurement has been performed, you can analyze the results in various ways.

- Result Configuration....71
- Markers....86
- Trace Configuration....92
- Zoom Functions....97

6.1 Result Configuration

Some evaluation methods require or allow for additional settings to configure the result display. Note that the available settings depend on the selected window (see "Specifics for" on page 44).

The "Result Configuration" dialog box is displayed when you do one of the following:

- In the "Overview", select "Result Config".
- In the "Meas Setup" menu, select "Result".

- Pulse Selection....71
- Result Range....72
- Parameter Configuration for Result Displays....73
- Table Configuration....79
- Y-Scaling....83
- Units....86

6.1.1 Pulse Selection

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse.

► To select a pulse, in the "Meas Setup" menu, select "Selected Pulse".

The currently selected pulse is highlighted blue in the Pulse Results and Pulse Statistics displays.

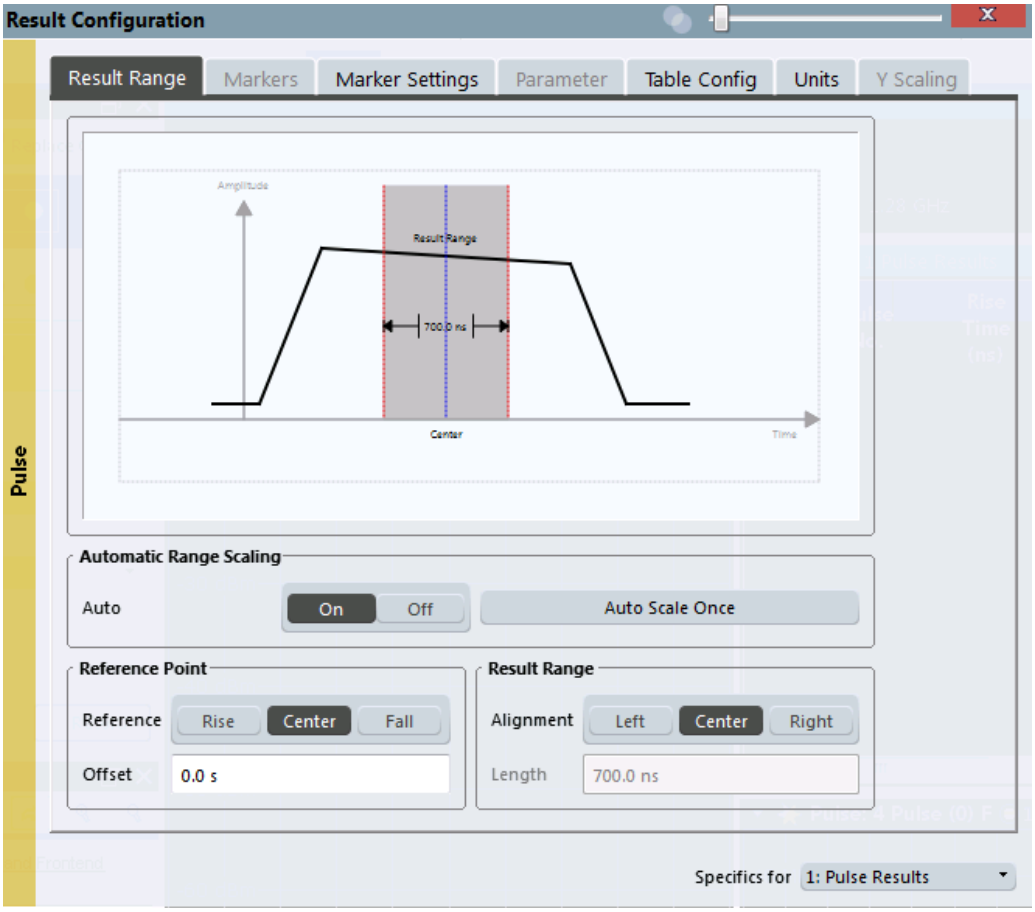
As soon as a new pulse is selected, all pulse-specific displays are automatically updated.

Remote command:

`SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 145

6.1.2 Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 11). This range applies to the pulse magnitude, frequency and phase vs time displays.



The range is defined by a reference point, alignment and the range length.

Automatic Range Scaling....72
Result Range Reference Point....73
Offset....73
Alignment....73
Length....73

Automatic Range Scaling
Defines whether the result range length is determined automatically according to the width of the selected pulse (see chapter 6.1.1, "Pulse Selection", on page 71).

Note: The result range is applied to all pulse-based result displays.

"OFF" Switches automatic range scaling off

"ON" Switches automatic range scaling on

"ONCE" Executes automatic range scaling once and then switches it off

Remote command:
SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO on page 145

Result Range Reference Point
Defines the reference point for positioning the result range. The Offset is given with respect to this value.

"Rise" The result range is defined in reference to the rising edge.

"Center" The result range is defined in reference to the center of the pulse top.

"Fall" The result range is defined in reference to the falling edge.

Remote command:
SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence on page 146

Offset
The offset in seconds from the pulse edge or center at which the result range reference point occurs.

Remote command:
SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet on page 146

Alignment
Defines the alignment of the result range in relation to the selected Result Range Reference Point.

"Left" The result range starts at the pulse center or selected edge.

"Center" The result range is centered around the pulse center or selected edge.

"Right" The result range ends at the pulse center or selected edge.

Remote command:
SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment on page 145

Length
Defines the length or duration of the result range.

Remote command:
SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth on page 146

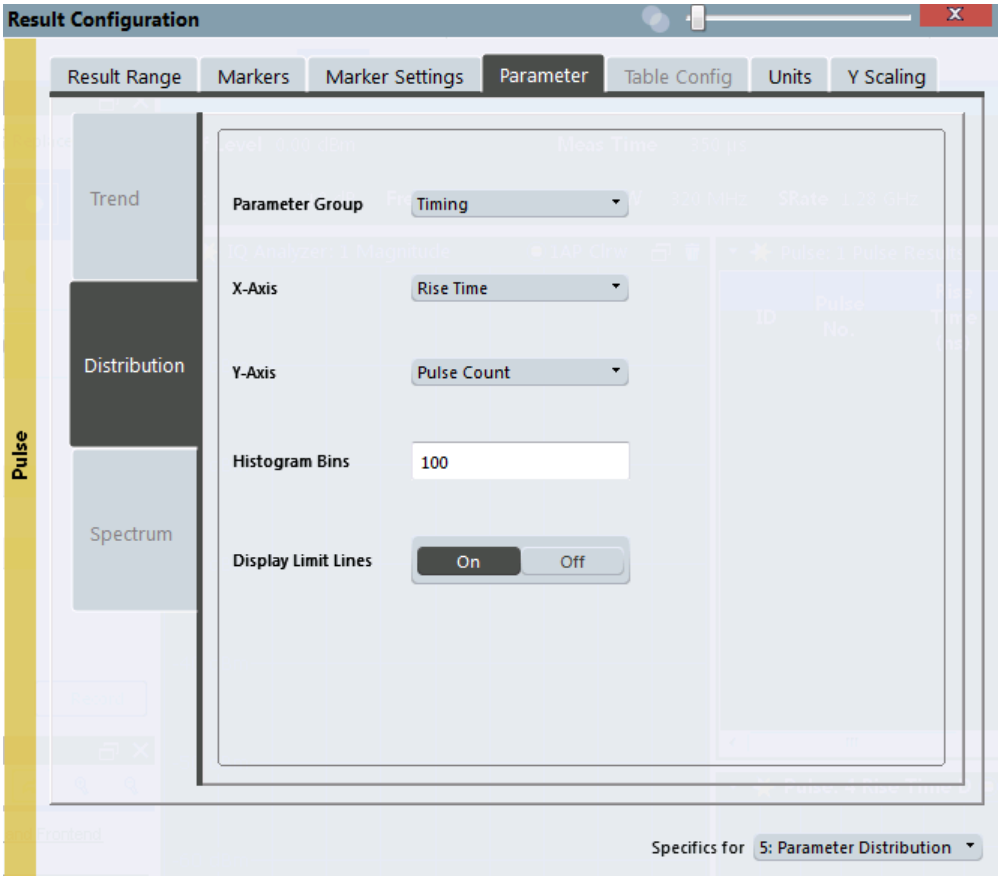
6.1.3 Parameter Configuration for Result Displays

For parameter trend or distribution displays you can define which parameters are to be evaluated in each window.

- Parameter Distribution Configuration....74
- Parameter Spectrum Configuration....75
- Parameter Trend Configuration....78

6.1.3.1 Parameter Distribution Configuration

The parameter distribution evaluations allow you to visualize the number of occurrances for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.



This tab is only available for windows with a Parameter Distribution evaluation.

Parameter Group 74
X-Axis 75
Y-Axis 75
Histogram Bins 75
Display Limit Lines 75

Parameter Group
Defines the group of parameters from which one can be selected to display the distribution of the measured values on the y-axis. For a description of the parameters see chapter 3.1, "Pulse Parameters", on page 11.

X-Axis
Defines the parameter for which the values are displayed on the x-axis. The available parameters depend on the selected Parameter Group.

Remote command:
`CALCulate<n>:DISTribution:<GroupName> <X-Axis>,<Y-Axis>`, see e.g.
`CALCulate<n>:DISTribution:FREQuency` on page 147

Y-Axis
Defines the scaling of the y-axis.

"Pulse count" Number of pulses in which the value occurred.

"Occurrence" Number of occurrences in percent of all measured values.

Histogram Bins
Number of columns on the x-axis, i.e. the number of measurement value ranges for which the occurrences are determined.

Remote command:
`CALCulate<n>:DISTribution:NBINs` on page 148

Display Limit Lines
Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

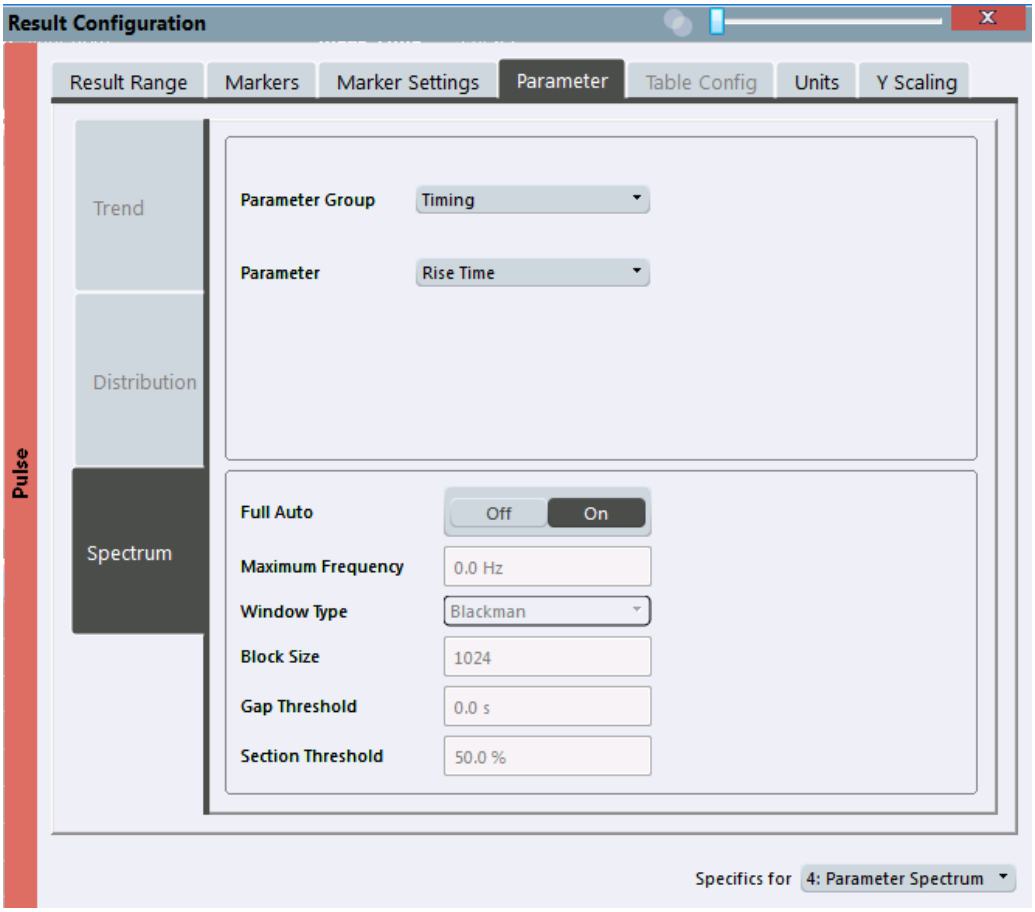
Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 148
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 161

6.1.3.2 Parameter Spectrum Configuration

Calculates an FFT for a selected column of the Pulse Results table. This "spectrum" allows you to easily determine the frequency of periodicities in the pulse parameters.

For each Parameter Spectrum window you can configure which measured parameter is to be displayed and how the spectrum is determined.



This tab is only available for windows with a Parameter Spectrum evaluation.

For more information on how the parameter spectrum is calculated see chapter 4.3, "Parameter Spectrum Calculation", on page 37.

Parameter Group 76
Parameter 77
Full Auto 77
Maximum Frequency 77
Window Type 77
Block Size 77
Gap Threshold 77
Section Threshold 77

Parameter Group
Defines the group of parameters from which one can be selected to display the FFT of the measured values. For a description of the parameters see chapter 3.1, "Pulse Parameters", on page 11.

Parameter
Defines the parameter for which the FFT is calculated and displayed. The available parameters depend on the selected Parameter Group.

Remote command:
`CALCulate<n>:PSPectrum:<GroupName> <X-Axis>`, see e.g. `CALCulate<n>:PSPectrum:FREQuency` on page 153

Full Auto
Determines the Parameter Spectrum settings automatically. For most measurement cases, automatic configuration should be suitable.

If enabled, the individual settings are not available.

Remote command:
`CALCulate<n>:PSPectrum:AUTO` on page 152

Maximum Frequency
Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000). Limiting the span to the actually required frequencies decreases the calculation time and can improve the obtained RBW.

Remote command:
`CALCulate<n>:PSPectrum:MAXFrequency` on page 153

Window Type
Used FFT window type

Remote command:
`CALCulate<n>:PSPectrum:WINDow` on page 157

Block Size
Size of block used in spectrum calculation. Windowing and averaging are used to combine blocks. The block size also determines the resulting RBW of the spectrum.

Remote command:
`CALCulate<n>:PSPectrum:BLOCksize` on page 152

Gap Threshold
Minimum time that must pass before a gap is detected as such.

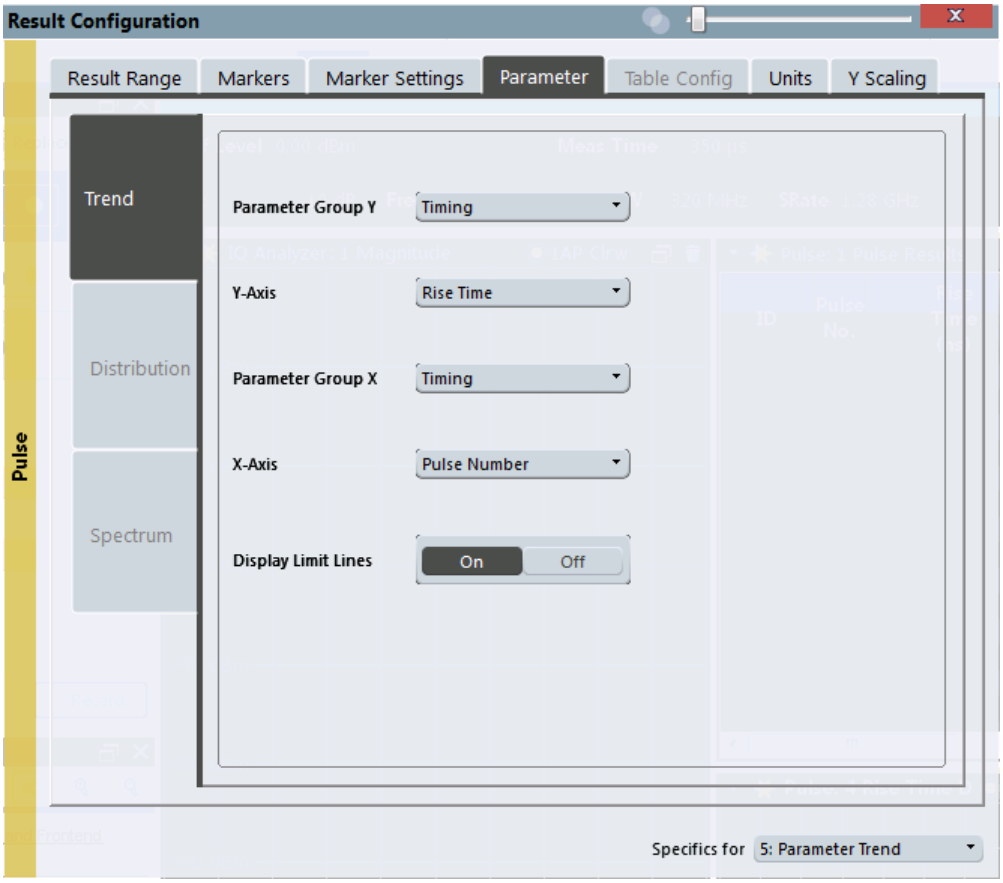
Remote command:
`CALCulate<n>:PSPectrum:GTHReshold` on page 153

Section Threshold
Minimum section size as a percentage of the block size. Sections that are smaller than the threshold are ignored and considered to be in the detected gap.

Remote command:
`CALCulate<n>:PSPectrum:STHReshold` on page 156

6.1.3.3 Parameter Trend Configuration

The parameter trend result displays allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed on the x-axis and which on the y-axis.



This tab is only available for windows with a Parameter Trend result display.

Parameter Group Y 78
Y-Axis 79
Parameter Group X 79
X-Axis 79
Display Limit Lines 79

Parameter Group Y
Defines the group of parameters from which one can be selected to display the trend on the y-axis. For a description of the parameters see chapter 3.1, "Pulse Parameters", on page 11.

Y-Axis
Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected "Parameter Group Y" on page 78.

Remote command:
`CALCulate<n>:TRENd:<GroupName>:Y`, see e.g. `CALCulate<n>:TRENd:FREQuency:Y` on page 160
`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 158

Parameter Group X
Defines the group of parameters from which one can be selected to display the trend on the x-axis. For a description of the parameters see chapter 3.1, "Pulse Parameters", on page 11.

X-Axis
Defines the parameter for which the trend is displayed on the y-axis. The available parameters depend on the selected Parameter Group X.

Remote command:
`CALCulate<n>:TRENd:<GroupName>:X`, see e.g. `CALCulate<n>:TRENd:FREQuency:X` on page 159
`CALCulate<n>:TRENd:<GroupName> Y,X`, see e.g. `CALCulate<n>:TRENd:FREQuency` on page 158

Display Limit Lines
Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

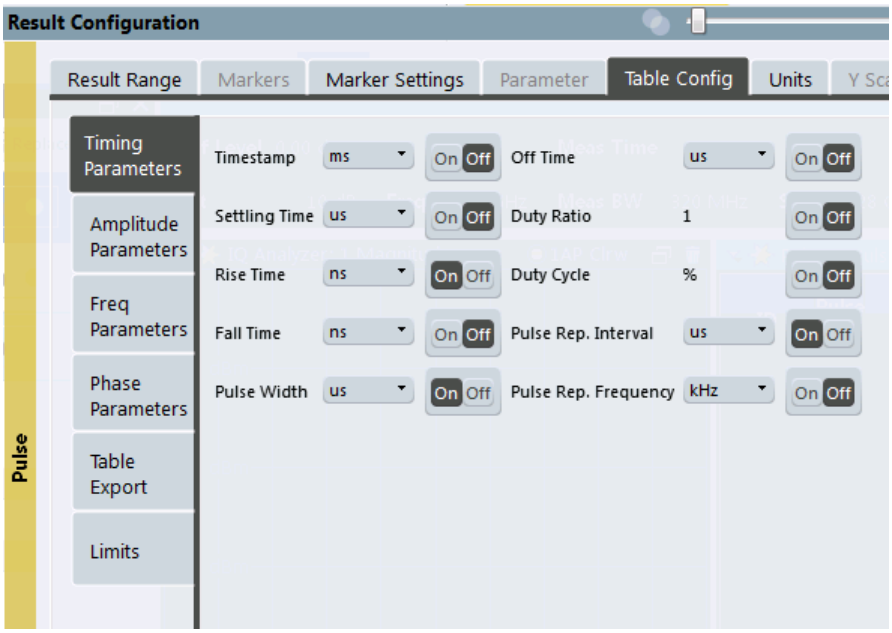
Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Remote command:
`CALCulate<n>:DISTribution:LLINes[:STATe]` on page 148
`CALCulate<n>:TRENd:LLINes[:STATe]` on page 161

6.1.4 Table Configuration

During each measurement, a large number of statistical and characteristic values are determined. The "Pulse Statistics" and "Pulse Results" result displays provide an overview of the parameters selected here.

Note that the "Result Configuration" dialog box is window-specific; table configuration settings are only available if a table display is selected. However, the table configuration applies to *all* tables, regardless of which table is selected.



Select the parameters to be included in the tables, and the required unit scaling, if available. For a description of the individual parameters see chapter 3.1, "Pulse Parameters", on page 11.

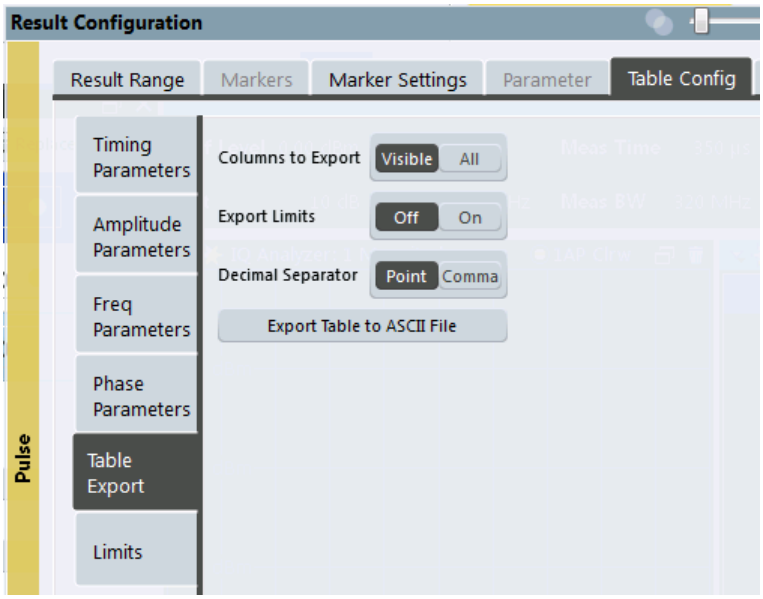
Remote command:

`CALCulate<n>:TABLe:<GroupName>:<ParamName>`, see chapter 8.4.10.6, "Configuring the Statistics and Parameter Tables", on page 174

6.1.4.1 Table Export Configuration

Table results can be exported to an ASCII file for further evaluation in other (external) applications. Table export settings can be configured in the "Result Configuration" dialog box, in the "Table configuration" tab, in the vertical "Table Export" tab.

The settings are window-specific and only available for result tables.



The result tables can be exported either directly in the settings dialog box or via the "Export" function in the "Save/Recall" menu (via the toolbar).

Columns to Export....81
Decimal Separator....81
Export Table to ASCII File....81

Columns to Export
Defines which of the result table columns are to be included in the export file.

"Visible" Only the currently visible columns in the result display are exported.

"All" All columns, including currently hidden ones, for the result display are exported.

Remote command:
`MMEMory:STORe<n>:TABLe` on page 244

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 243

Export Table to ASCII File
Opens a file selection dialog box and saves the selected result table in ASCII format (`.DAT`) to the specified file and directory.

For details on the file format see chapter A.3, "Reference: ASCII File Export Format", on page 261.

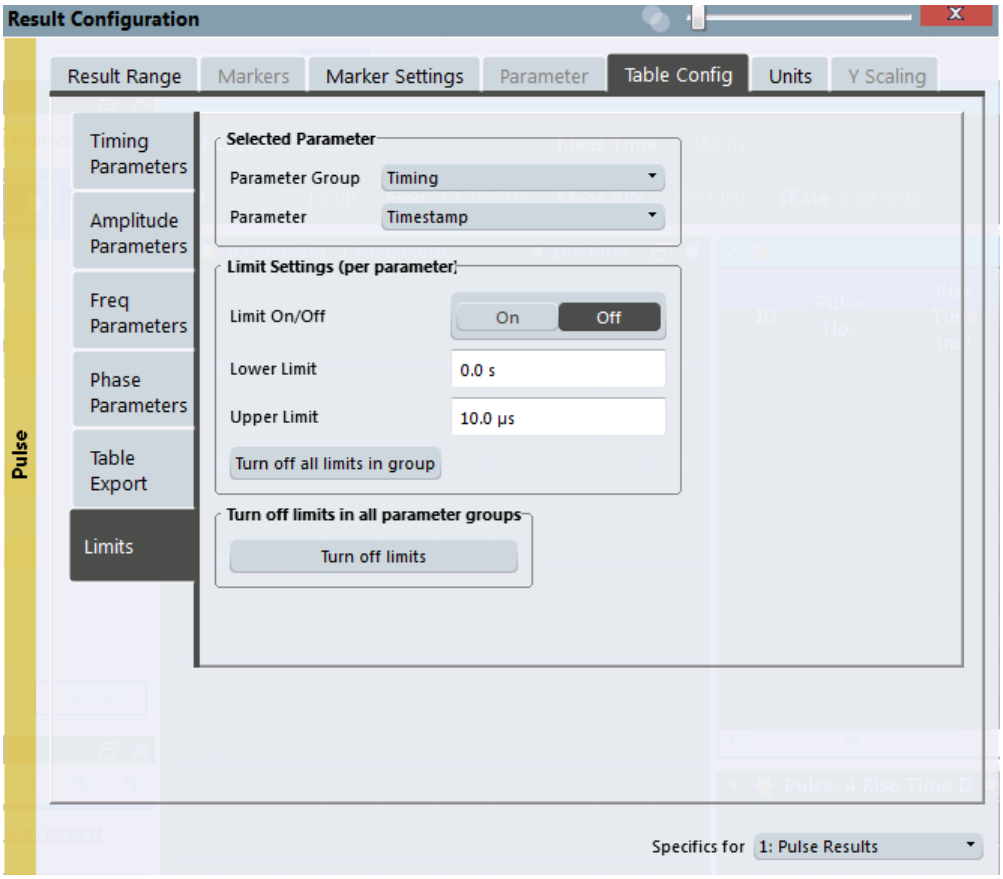
Note: To store the measurement results for **all** traces and tables in **all** windows, use the Export Trace to ASCII File command in the "Save/Recall" > "Export" menu. (See also chapter 6.3.2, "Trace / Data Export Configuration", on page 96.)

Remote command:
`MMEMory:STORe<n>:TABLe` on page 244

6.1.4.2 Limit Settings for Table Displays

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. Table limit settings can be configured in the "Result Configuration" dialog box, in the "Table configuration" tab, in the vertical "Limits" tab.

For details on limits see "Pulse Results" on page 28.



The settings are window-specific and only available for result tables.

Optionally, limit lines can be displayed in the Parameter Distribution and Parameter Trend diagrams. You can drag these lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

Parameter Group 83
Parameter 83
Activating a limit check for a parameter 83
Defining lower and upper limits for a parameter 83
Deactivating a limit check for an entire parameter group 83
Deactivating all limit checks for all parameter groups 83

Parameter Group
Defines the group of parameters from which one can be selected to define limits. For a description of the parameters see chapter 3.1, "Pulse Parameters", on page 11.

Parameter
Defines the parameter for which the limits are to be defined. The available parameters depend on the selected Parameter Group.

Activating a limit check for a parameter
To activate a limit check for the selected parameter, set "Limit On/Off" to "ON".

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe` on page 187

Defining lower and upper limits for a parameter
The "Lower Limit" and "Upper Limit" define the valid value range for the limit check for the selected parameter.

Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 189

Deactivating a limit check for an entire parameter group
To deactivate all limits for an entire parameter group at once, select "Turn off all limits in group". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in the group.

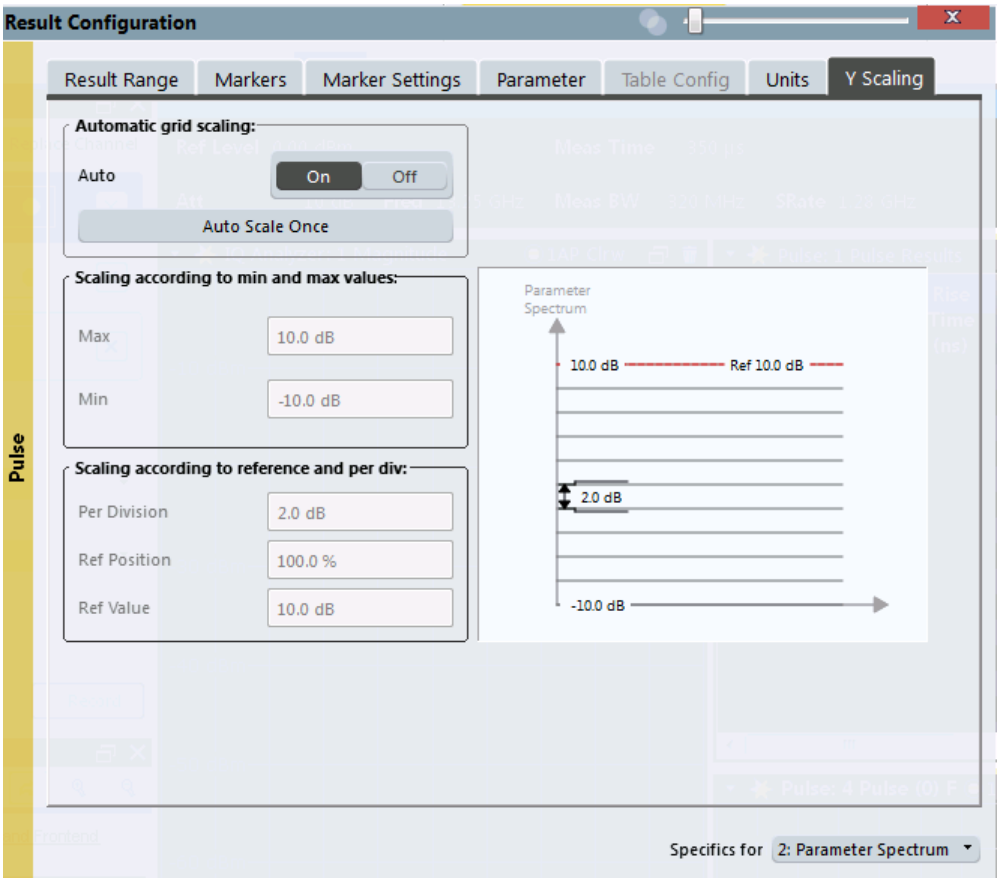
Remote command:
`CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe` on page 188

Deactivating all limit checks for all parameter groups
To deactivate all limits for all parameter groups at once, select "Turn off limits". This function is identical to setting "Limit On/Off" to "OFF" for each parameter in each group.

Remote command:
`CALCulate<n>:TABLe:ALL:LIMit:STATe` on page 189

6.1.5 Y-Scaling

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These settings are described here.



To display this dialog box, do one of the following:

- From the "Overview", select "Result Configuration", then switch to the "Y-Scaling" tab.
- From the "Meas Setup" menu, select "Scale".

Automatic Grid Scaling....84
Auto Scale Once....85
Absolute Scaling (Min/Max Values)....85
Relative Scaling (Reference/ per Division)....85
└ Per Division....85
└ Ref Position....85
└ Ref Value....85

Automatic Grid Scaling
The y-axis is scaled automatically according to the current measurement settings and results (continuously).

Note: If a limit is defined for a parameter that is displayed in a Parameter Trend diagram (see "Activating a limit check for a parameter" on page 83), autoscaling is not available for the axis this parameter is displayed on.

Note: Tip: To update the scaling automatically *once* when this setting for continuous scaling is off, use the "Auto Scale Once" on page 85 button or the softkey in the AUTO SET menu.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 190

Auto Scale Once
Automatically determines the optimal range and reference level position to be displayed for the current measurement settings.

The display is only set once; it is not adapted further if the measurement settings are changed again.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 190

Absolute Scaling (Min/Max Values)
Define the scaling using absolute minimum and maximum values.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum` on page 191
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum` on page 191

Relative Scaling (Reference/ per Division)
Define the scaling relative to a reference value, with a specified value range per division.

Per Division ← Relative Scaling (Reference/ per Division)
Defines the value range to be displayed per division of the diagram (1/10 of total range).

Note: The value defined per division refers to the default display of 10 divisions on the y-axis. If fewer divisions are displayed (e.g. because the window is reduced in height), the range per division is increased in order to display the same result range in the smaller window. In this case, the per division value does not correspond to the actual display.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision` on page 192

Ref Position ← Relative Scaling (Reference/ per Division)
Defines the position of the reference value in percent of the total y-axis range.

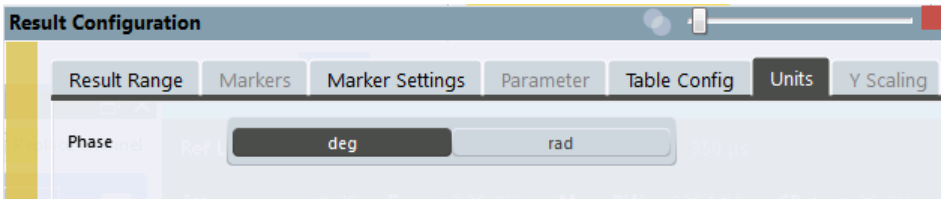
Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition` on page 192

Ref Value ← Relative Scaling (Reference/ per Division)
Defines the reference value to be displayed at the specified reference position.

Remote command:
`DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue` on page 192

6.1.6 Units

The unit for phase display is configurable. This setting is described here.



Phase Unit....86

Phase Unit
Defines the unit in which phases are displayed (degree or rad).

Remote command:
`UNIT:ANGLe` on page 193

6.2 Markers

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display.

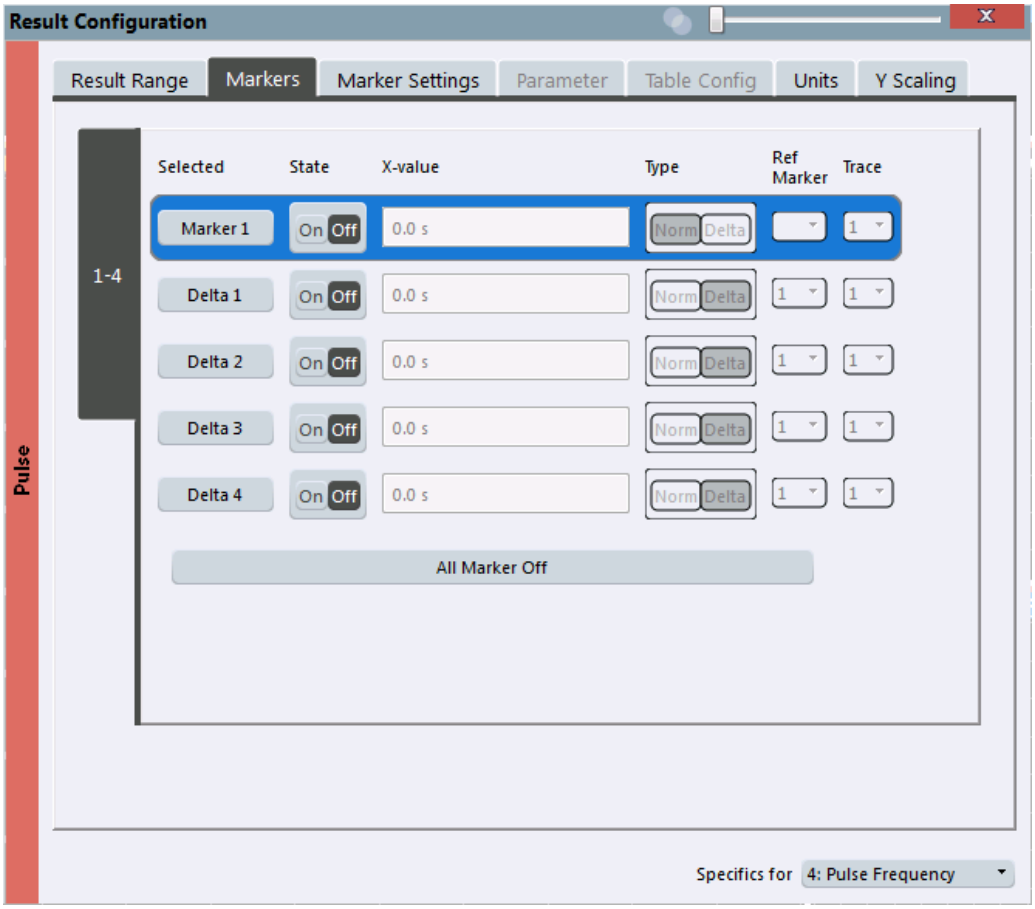
Markers are configured in the "Marker" dialog box which is displayed when you do one of the following:

- In the "Overview", select "Result Config", and switch to the "Marker" tab.
- In the "Marker" menu select "Marker".

- Individual Marker Settings....86
- General Marker Settings....90
- Marker Positioning Functions....91

6.2.1 Individual Marker Settings

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.



Marker 1 / Marker 2 / Marker 3 / Marker 4 87
Place New Marker 88
M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16 88
Selected Marker 88
Marker State 89
X-value 89
Marker Type 89
Reference Marker 89
Assigning the Marker to a Trace 89
Select Marker 90
All Markers Off 90

Marker 1 / Marker 2 / Marker 3 / Marker 4

The "Marker X" softkey activates the corresponding marker and opens an edit dialog box to enter the marker position ("X-value"). Pressing the softkey again deactivates the selected marker.

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

If normal marker 1 is the active marker, pressing the "Mkr Type" softkey switches on an additional delta marker 1.

Note: Setting markers in Parameter Trend Displays. In Parameter Trend displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value (as in the "Marker Configuration" dialog box) can be very difficult or unambiguous. Thus, markers are positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter trend displays, regardless of the displayed x-axis parameter. However, the position displayed in the marker information area or the marker table is shown in the defined x-axis unit.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 198
`CALCulate<n>:MARKer<m>:X` on page 198
`CALCulate<n>:MARKer<m>:Y?` on page 246
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 200
`CALCulate<n>:DELTamarker<m>:X` on page 200
`CALCulate<n>:DELTamarker<m>:Y?` on page 246

Place New Marker
Activates the next currently unused marker and sets it to the peak value of the current trace in the current window.

Marker 1/ Delta 1/ Delta 2/.../Delta 16
When you select the arrow on the marker selection list in the toolbar, or select a marker from the "Marker > Select Marker" menu, the marker is activated and an edit dialog box is displayed to enter the marker position ("X-value").

To deactivate a marker, select the marker name in the marker selection list in the toolbar (not the arrow) to display the "Select Marker" dialog box. Change the "State" to "Off".

Marker 1 is always the default reference marker for relative measurements. If activated, markers 2 to 16 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display using the "Marker Type" function.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 198
`CALCulate<n>:MARKer<m>:X` on page 198
`CALCulate<n>:MARKer<m>:Y?` on page 246
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 200
`CALCulate<n>:DELTamarker<m>:X` on page 200
`CALCulate<n>:DELTamarker<m>:X:RELative?` on page 246
`CALCulate<n>:DELTamarker<m>:Y?` on page 246

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 198
CALCulate<n>:DELTamarker<m>[:STATe] on page 200

X-value
Defines the position of the marker on the x-axis.

Note: Setting markers in Parameter Trend Displays. In Parameter Trend displays, especially when the x-axis unit is not pulse number, positioning a marker by defining its x-axis value can be very difficult or unambiguous. Thus, markers can be positioned by defining the corresponding pulse number in the "Marker" edit field for all parameter trend displays, regardless of the displayed x-axis parameter. The "Marker" edit field is displayed when you select one of the "Marker" softkeys.

Remote command:
CALCulate<n>:DELTamarker<m>:X on page 200
CALCulate<n>:MARKer<m>:X on page 198

Marker Type

Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 198
CALCulate<n>:DELTamarker<m>[:STATe] on page 200

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

Remote command:
CALCulate<n>:DELTamarker<m>:MREF on page 199

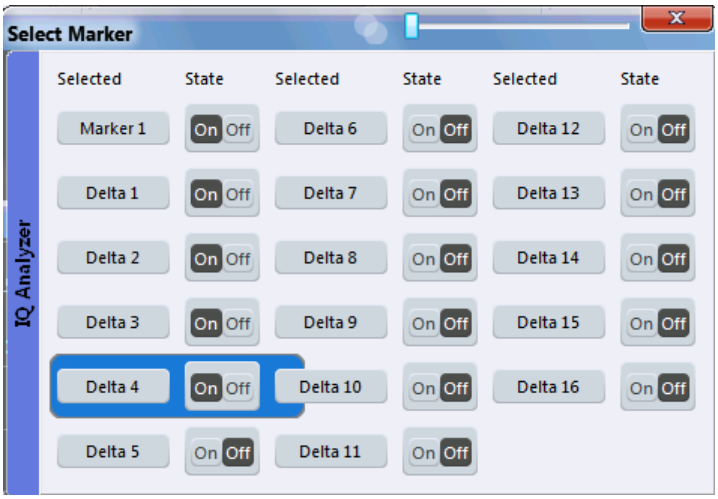
Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
CALCulate<n>:MARKer<m>:TRACe on page 198

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.



Remote command:
Marker selected via suffix <m> in remote commands.

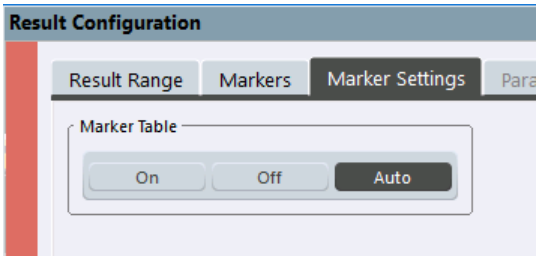
All Markers Off

Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 197

6.2.2 General Marker Settings

General marker settings are defined in the "Marker Settings" tab of the "Result Configuration" dialog box.



Marker Table Display
Defines how the marker information is displayed.

"On"	Displays the marker information in a table in a separate area beneath the diagram.
"Off"	Displays the marker information within the diagram area.
"Auto"	(Default) Up to two markers are displayed in the diagram area. If more markers are active, the marker table is displayed automatically.

Remote command:
`DISPlay:MTABle` on page 201

6.2.3 Marker Positioning Functions

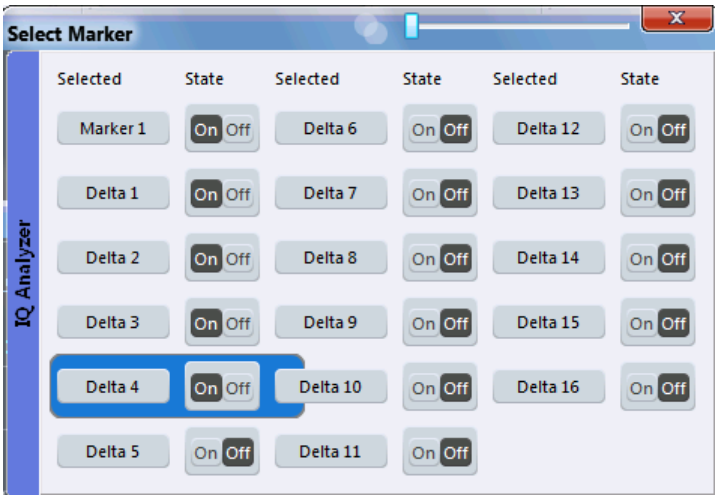
The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value.

These functions are available via the "Marker" toolbar.

Select Marker....91
Peak Search....91
Search Next Peak....92
Search Minimum....92
Search Next Minimum....92

Select Marker

The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.



Remote command:
Marker selected via suffix <m> in remote commands.

Peak Search

Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MAXimum[:PEAK] on page 204
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] on page 202

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MAXimum:NEXT on page 203
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT on page 202

Search Minimum

Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MINimum[:PEAK] on page 204
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] on page 203

Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

Remote command:
CALCulate<n>:MARKer<m>:MINimum:NEXT on page 204
CALCulate<n>:DELTamarker<m>:MINimum:NEXT on page 203

6.3 Trace Configuration

Traces in graphical result displays based on the defined result range (see chapter 6.1.2, "Result Range", on page 72) can be configured, for example to perform statistical evaluations over a defined number of measurements, pulses, or samples.

The trace settings are configured in the "Traces" dialog box which is displayed when you do the following:

- Select the "Trace > Trace..." menu item.

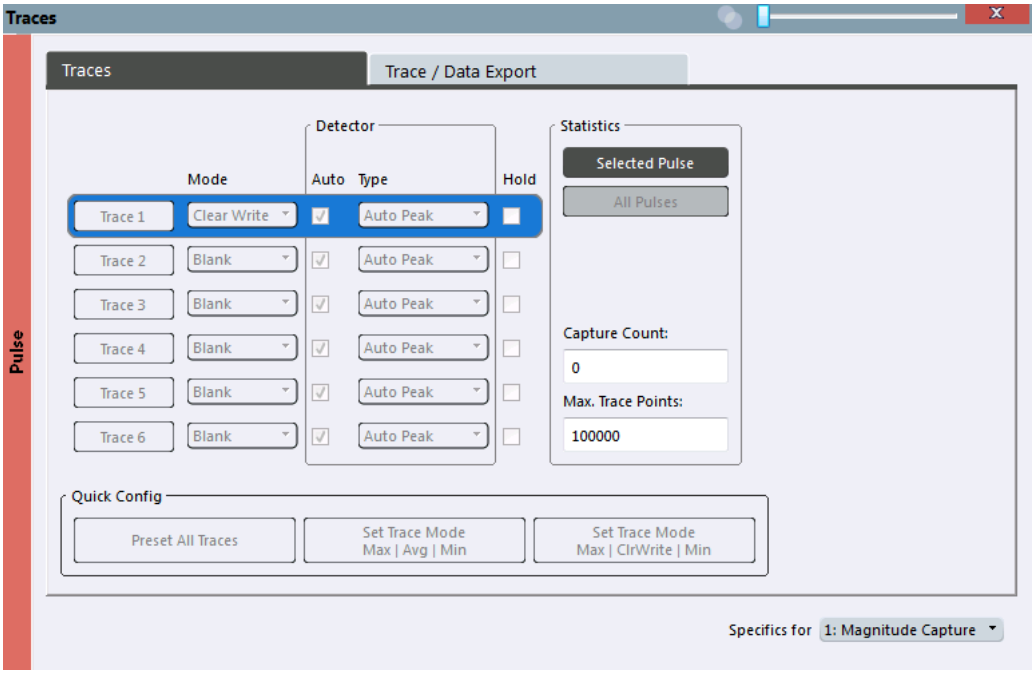
For details on trace evaluation see chapter 4.5, "Trace Evaluation", on page 41.

Trace data can also be exported to an ASCII file for further analysis. For details see chapter 6.3.2, "Trace / Data Export Configuration", on page 96.

6.3.1 Trace Settings

You can configure the settings for up to 6 individual traces for the following result displays, which are based on the defined result range (see chapter 6.1.2, "Result Range", on page 72):

- "Pulse Frequency" on page 25
- "Pulse Magnitude" on page 25
- "Pulse Phase" on page 26
- "Pulse Phase (Wrapped)" on page 27



Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6 93
Trace Mode 94
Detector 94
Hold 94
Statistical Evaluation 95
└ Selected Pulse vs All Pulses 95
└ Capture / Average Count 95
└ Maximum number of trace points 95
Predefined Trace Settings - Quick Config 95
Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys) 96

Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6
Selects the corresponding trace for configuration. The currently selected trace is highlighted orange.

For the Magnitude Capture result display, only one trace is available, which cannot be configured.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>[:STATe] on page 195
Selected via numeric suffix of TRACe<t> commands

Trace Mode
Defines the update mode for subsequent traces.

"Clear Write" Overwrite mode: the trace is overwritten by each measurement. This is the default setting.

"Max Hold" The maximum value is determined over several measurements and displayed. The R&S VSE saves each trace point in the trace memory only if the new value is greater than the previous one.

"Min Hold" The minimum value is determined from several measurements and displayed. The R&S VSE saves each trace point in the trace memory only if the new value is lower than the previous one.

"Average" The average is formed over several measurements.

"View" The current contents of the trace memory are frozen and displayed.

"Blank" Removes the selected trace from the display.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:MODE on page 194

Detector
Defines the trace detector to be used for trace analysis.

"Auto" Selects the optimum detector for the selected trace and filter mode. This is the default setting.

"Type" Defines the selected detector type.

Remote command:
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] on page 195
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO on page 196

Hold
If activated, traces in "Min Hold", "Max Hold" and "Average" mode are not reset after specific parameter changes have been made.

Normally, the measurement is started again after parameter changes, before the measurement results are analyzed (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

The default setting is off.

Remote command:
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous on page 194

Statistical Evaluation
If the trace modes "Average", "Max Hold" or "Min Hold" are set, you can define how many pulses, measurements and measurement samples are included in the statistical evaluation.

For details see chapter 4.5.1, "Trace Statistics", on page 41.

Selected Pulse vs All Pulses ← Statistical Evaluation
Defines which pulses are included in the statistical evaluation.

"Selected pulse"	Only the selected pulse from each measurement is included in the statistical evaluation.
"All Pulses"	All measured pulses from each measurement are included in the statistical evaluation.

Remote command:
`[SENSe:][STATistic<n>:]TYPE` on page 196

Capture / Average Count ← Statistical Evaluation
Defines the number of measurements to be performed in the single capture mode. Values from 0 to 200000 are allowed. If the values 0 or 1 are set, one measurement is performed.

In continuous capture mode, if sweep count = 0 (default), averaging is performed over 10 measurements. For capture count =1, no averaging, maxhold or minhold operations are performed.

The "Average Count" also determines the number of measurements used to calculate the pulse trace statistics for the result range displays (see chapter 4.5.1, "Trace Statistics", on page 41).

Remote command:
`[SENSe:]SWEep:COUNt` on page 195
`[SENSe:]AVERage<n>:COUNt` on page 195

Maximum number of trace points ← Statistical Evaluation
If the number of samples within the result range (see chapter 6.1.2, "Result Range", on page 72) is larger than this value, the trace data is reduced to the defined maximum number of trace points using the selected detector.

Restricting this value can improve performance during statistical evaluation of large result range lengths.

Remote command:
`[SENSe:]SWEep:POINts` on page 197

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
		Blank

Function	Trace Settings	
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average
	Trace 3:	Min Hold
		Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)
Displays the "Traces" settings and focuses the "Mode" list for the selected trace.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>[:STATe]` on page 195

6.3.2 Trace / Data Export Configuration

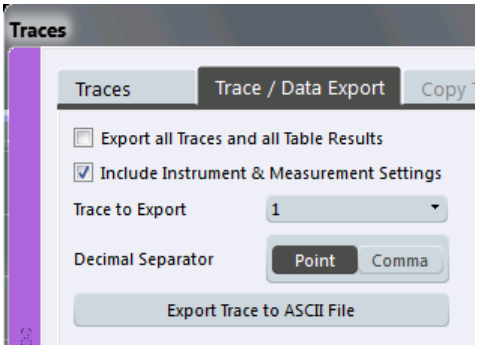
The R&S VSE provides various evaluation methods for the results of the performed measurements. However, you may want to evaluate the data with other, external applications. In this case, you can export the measurement data to an ASCII file.

The standard data management functions (e.g. saving or loading instrument settings, or exporting the I/Q data in other formats) that are available for all R&S VSE applications are not described here.

See the R&S VSE User Manual for a description of the standard functions.

Trace and data export settings can be configured in the "Traces" dialog box ("Trace/ Data Export" tab).

Alternatively, they are available in the "Save/Recall" menu (> "Export" softkey) which is displayed when you select the "Save" or "Open" icon in the toolbar.



Export all Traces and all Table Results....97
Include Instrument Measurement Settings....97
Trace to Export....97
Decimal Separator....97
Export Trace to ASCII File....97

Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. Result Summary, marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`FORMat:DEXPort:TRACes` on page 244

Include Instrument Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 243

Trace to Export
Defines an individual trace that will be exported to a file.

This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 243

Export Trace to ASCII File
Opens a file selection dialog box and saves the selected trace in ASCII format (`.dat`) to the specified file and directory.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 208

6.4 Zoom Functions

The zoom functions are only available from the toolbar.

Single Zoom....98
Multiple Zoom....98
Restore Original Display....98
Deactivating Zoom (Selection mode)....98

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 205
`DISPlay[:WINDow<n>]:ZOOM:AREA` on page 205

Multiple Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 206
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA` on page 205

Restore Original Display

Restores the original display and closes all zoom windows.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 205 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 206 (for each multiple zoom window)

Deactivating Zoom (Selection mode)
Deactivates any zoom mode.

Selecting a point in the display no longer invokes a zoom, but selects an object.

Remote command:
`DISPlay[:WINDow<n>]:ZOOM:STATe` on page 205 (single zoom)
`DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe` on page 206 (for each multiple zoom window)

7 How to Perform Measurements in the Pulse Application

The following step-by-step instructions demonstrate how to perform a Pulse measurement with the R&S VSE Pulse application.

- How to Perform a Standard Pulse Measurement.....99
- How to Configure a Limit Check for a Pulse Measurement..... 100

7.1 How to Perform a Standard Pulse Measurement

To perform a standard pulse measurement

1. Open a new channel or replace an existing one and select the "Pulse" application.
2. Select the "Meas Setup > Overview" menu item to display the "Overview" for a Pulse measurement.
3. Select the "Signal Description" button and configure the expected pulse characteristics.
4. Select the "Input/Frontend" button to define the input signal's center frequency, amplitude and other basic settings.
5. Optionally, select the "Trigger" button and define a trigger for data acquisition, for example an external trigger to start capturing data only when a useful signal is transmitted.
6. Select the "Data Acquisition" button and define the bandwidth parameters for the input signal:
   - "Measurement Bandwidth": the amount of signal bandwidth to be captured
   - "Measurement Time": how long the input signal is to be captured
7. Select the "Pulse Detection" button and define the criteria to detect the individual pulses within the input signal.
8. Select the "Measurement" button and define the general measurement settings concerning:
   - the measurement levels
   - the measurement point
   - the measurement range
9. Select the "Add Window" icon from the toolbar to add further result displays for the Pulse channel.
10. Select "Meas Setup > Overview" to display the "Overview".

11. Select the "Result Config" button in the "Overview" to configure which data is displayed in the individual result displays, and other settings for specific evaluation methods. These settings can be configured individually for each window, so select the window first and then configure the settings.
    - Define the "Result Range", which determines the extent of measured data displayed in pulse magnitude, frequency and phase vs time traces.
    - Configure specific settings for the selected evaluation method(s).
    - Configure a limit check (see chapter 7.2, "How to Configure a Limit Check for a Pulse Measurement", on page 100)
    - Configure markers and delta markers to determine deviations and offsets within the results, e.g. when comparing errors or peaks.
    - Adapt the diagram scaling to the displayed data.
    - Optionally, configure the trace to display the average over a series of measurements. If necessary, increase the "Capture/Average Count" in the "Capture" dialog box.
12. In the "Control" toolbar, or in the "Sequence" tool window, select →| "Single" capture mode, then select the ▶ "Capture" function to stop the continuous measurement mode and start a defined number of measurements.
13. Select "Meas Setup > Selected Pulse" and select a specific pulse to be evaluated.

    The result displays are updated to show the results for the selected pulse.

7.2 How to Configure a Limit Check for a Pulse Measurement

To configure a limit check for a pulse measurement

Measurement results can be checked against defined limits and the results of the limit check can then be indicated in the Result Table. This procedure assumes a standard pulse measurement has been defined (as described in chapter 7.1, "How to Perform a Standard Pulse Measurement", on page 99) and a Result Table display is active.

1. Select the "Result Config" button in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. Select the parameter for which you want to perform a limit check.
   For details on available parameters and parameter groups see chapter 3.1, "Pulse Parameters", on page 11.
5. Toggle the "Limit On/Off" setting to "On".
6. Define the lower or upper limit value, or both.

7. Repeat step 4 to step 6 for each parameter you want to perform a limit check on.

   The measured values and all newly measured values for the specified parameter are compared to the defined limit values.
   If the measured value remains above the lower limit and below the upper limit, it is displayed in green in the Result Table.
   If the measured value exceeds either limit value, it it displayed in red in the Result Table.

Changing the limit values graphically

Limit lines can also be displayed in Parameter Trend or Parameter Distribution result displays ("Meas Setup > Result Config" > "Parameter" tab > "Display Limit Lines").

You can drag these limit lines to a new position in the window. The new position is maintained, the limit check is repeated, and the results of the limit check in any active table displays are adapted.

To deactivate a limit check

1. Select the "Result Config" button in the "Overview".
2. If necessary, select the Result Table from the "Specifics for" list of windows.
3. Switch to the "Table Config" tab, then select the "Limits" tab.
4. - To deactivate the limit check for a single parameter, select the parameter and toggle the the "Limit On/Off" setting to "Off".
   - To deactivate the limit check for an entire parameter group, select "Turn off all limits in group".
   - To deactivate the limit check for all parameters in all parameter groups, select "Turn off limits".

8 Remote Commands for Pulse Measurements

The following commands are required to perform measurements in the R&S VSE Pulse application in a remote environment.

It is assumed that the R&S VSE has already been set up for remote control in a network as described in the R&S VSE Base Software User Manual.

General R&S VSE Remote Commands

The application-independent remote commands for general tasks on the R&S VSE are also available for Pulse measurements and are described in the R&S VSE Base Software User Manual. In particular, this comprises the following functionality:

- Controlling instruments and capturing data
- Managing Settings and Results
- Setting Up the Instrument
- Using the Status Register

Channel-specific commands

Apart from a few general commands on the R&S VSE, most commands refer to the currently active channel. Thus, always remember to activate a Pulsechannel before starting a remote program for a Pulsemeasurement.

After a short introduction, the tasks specific to the Pulse application are described here:

- Introduction 102
- Common Suffixes 107
- Activating Pulse Measurements 107
- Configuring the Measurement 108
- Analyzing Results 193
- Retrieving Results 206
- Programming Example: Pulse Measurement 247

8.1 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, in most cases, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, these are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the User Manual of the R&S VSE.

Remote command examples

Note that some remote command examples mentioned in this general introduction may not be supported by this particular application.

8.1.1 Conventions used in Descriptions

Note the following conventions used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitely.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S VSE follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  This is the unit used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

8.1.2 Long and Short Form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in upper case letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

8.1.3 Numeric Suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you don't quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

8.1.4 Optional Keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

Note that if an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

8.1.5 Alternative Keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

8.1.6 SCPI Parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, these are separated by a comma.

Example:

```
LAYout:ADD:WINDow Spectrum,LEFT,MTABle
```

Parameters may have different forms of values.

- Numeric Values 105
- Boolean 106
- Character Data 106
- Character Strings 107
- Block Data 107

8.1.6.1 Numeric Values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. In case of physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

with unit: `SENSe:FREQuency:CENTer 1GHZ`

without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. in case of discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.

- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. In some cases you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. In case of physical quantities, it applies the basic unit (e.g. Hz in case of frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

In some cases, numeric values may be returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned in case of errors.

8.1.6.2 Boolean

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying boolean parameters

When you query boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

8.1.6.3 Character Data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information see chapter 8.1.2, "Long and Short Form", on page 104.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

8.1.6.4 Character Strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

```
INSTRument:DELete 'Spectrum'
```

8.1.6.5 Block Data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

8.2 Common Suffixes

In the Pulse application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<m>	1..16	Marker
<n>	1..x	Window
<t>	1	Trace

8.3 Activating Pulse Measurements

Pulse measurements require a special application in the R&S VSE. The common commands for configuring and controlling measurement channels, as well as blocks and sequences, are also used in the R&S VSE Pulse application.

They are described in the R&S VSE Base Software User Manual.

8.4 Configuring the Measurement

The following remote commands are required to configure a Pulse measurement.

- Restoring the Default Configuration (Preset)..... 108
- Signal Description..... 108
- Input/Output Settings..... 111
- Frontend Configuration..... 114
- Triggering Measurements..... 119
- Data Acquisition..... 126
- Pulse Detection..... 128
- Configuring the Pulse Measurement..... 129
- Configuring the Result Display..... 134
- Configuring the Results..... 144

8.4.1 Restoring the Default Configuration (Preset)

SYSTem:PRESet:CHANnel[:EXECute]..... 108

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default software settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 44

8.4.2 Signal Description

The signal description provides information on the expected input signal, which optimizes pulse detection.

SENSe:TRACe:MEASurement:DEFine:DURation:AUTO..... 109
SENSe:TRACe:MEASurement:DEFine:DURation:MAX..... 109
SENSe:TRACe:MEASurement:DEFine:DURation:MIN..... 109
SENSe:TRACe:MEASurement:DEFine:DURation:OFF..... 109
SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet..... 109
SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO..... 110
SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE..... 110
SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO..... 110
SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop..... 110
SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation..... 111
SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod..... 111

SENSe:TRACe:MEASurement:DEFine:DURation:AUTO <State>

If this flag is set to ON, the pulse timing parameters (min/max width, min off time) are determined automatically from the current capture settings.

Parameters:
<State> ON | OFF | 0 | 1
*RST: ON

Manual operation: See "Timing Auto Mode" on page 46

SENSe:TRACe:MEASurement:DEFine:DURation:MAX <PulseMaxWidth>

Defines a maximum pulse width; pulses outside this range are not detected. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMaxWidth> *RST: 5 ms
Default unit: S

Manual operation: See "Minimum Pulse Width, Maximum Pulse Width" on page 46

SENSe:TRACe:MEASurement:DEFine:DURation:MIN <PulseMinWidth>

Defines a minimum pulse width; pulses outside this range are not detected. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMinWidth> *RST: 50 ns
Default unit: S

Manual operation: See "Minimum Pulse Width, Maximum Pulse Width" on page 46

SENSe:TRACe:MEASurement:DEFine:DURation:OFF <PulseMinOff>

The minimum time the pulse is "off", i.e. the time between successive pulses. This value is used to determine noise statistics and to reject short drops in amplitude during pulse "ON" time. The available value range is 50ns to 100s, but may be restricted further by the sample rate.

Parameters:
<PulseMinOff> *RST: 1 us
Default unit: S

Manual operation: See "Min Pulse Off Time" on page 46

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet <Offset>

Defines a known frequency offset to be corrected in the pulse acquisition data.

Use the `SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO` to define the frequency offset automatically.

Parameters:
<Offset> *RST: 0
Default unit: HZ

Manual operation: See "Frequency Offset Value" on page 46

SENSe:TRACe:MEASurement:DEFine:FREQuency:OFFSet:AUTO <State>

If enabled, the frequency offset is estimated automatically for each individual pulse.

Parameters:
<State> ON | OFF | 0 | 1
*RST: ON

Manual operation: See "Frequency Offset Auto Mode" on page 46

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE <PulseChirpRate>

Defines a known frequency chirp rate (in Hz/µs) to be used to generate an ideal pulse waveform for computing frequency and phase error parameters. This value is assumed constant for all measured pulses.

Use the `SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO` to define the chirp rate automatically.

Parameters:
<PulseChirpRate> *RST: 0
Default unit: Hz/µs

Manual operation: See "Chirp Rate" on page 47

SENSe:TRACe:MEASurement:DEFine:FREQuency:RATE:AUTO <State>

If enabled, the chirp rate is estimated automatically for each individual pulse.

Parameters:
<State> ON | OFF | 0 | 1
*RST: ON

Manual operation: See "Chirp Rate Auto Mode" on page 47

SENSe:TRACe:MEASurement:DEFine:PULSe:ADRoop <State>

If ON, a pulse can be modeled as having amplitude droop, otherwise the pulse top is assumed to be flat.

Parameters:
<State> ON | OFF | 0 | 1
*RST: ON

Manual operation: See "Pulse Has Droop" on page 45

SENSe:TRACe:MEASurement:DEFine:PULSe:MODulation <Modulation>

The type of pulse modulation which is expected.

Parameters:

<Modulation> ARB | CW | LFM | RIQ

ARB
Arbitrary

CW
Continuous wave

LFM
Linear FM (fixed value)

*RST: CW

Manual operation: See "Pulse Modulation" on page 46

SENSe:TRACe:MEASurement:DEFine:PULSe:PERiod <PulsePeriod>

This command defines how a pulse is detected.

Parameters:

<PulsePeriod> HL | LH

HL
The pulse period begins with the falling edge of the preceeding pulse and ends with the falling edge of the current pulse.

LH
The pulse period begins with the rising edge of the current pulse and end with the rising edge of the succeeding pulse.

*RST: HL

Manual operation: See "Pulse Period" on page 45

8.4.3 Input/Output Settings

The R&S VSE can analyze signals from different input sources (such as RF, power sensors etc.) and provide various types of output (such as noise or trigger signals). The following commands are required to configure data input and output.

I/Q file input
The commands for input from stored I/Q data files is described in the R&S VSE Base Software User Manual.

- RF Input 112
- Configuring the Outputs 113

8.4.3.1 RF Input

INPut:COUPling....112
INPut:FILTer:HPASs[:STATe]....112
INPut:FILTer:YIG[:STATe]....112
INPut:IMPedance....113
INPut:SELect....113

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType>
AC
AC coupling
DC
DC coupling
*RST: AC

Example:
```
INP:COUP DC
```

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 48

INPut:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the instrument in use in order to measure the harmonics for a DUT, for example.

This function requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG filter.)

Parameters:

<State>
ON | OFF
*RST: OFF

Example:
```
INP:FILT:HPAS ON
```
Turns on the filter.

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 48

INPut:FILTer:YIG[:STATe] <State>

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 48.

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 48

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:
<Impedance> 50 | 75
*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 48

INPut:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

Parameters:
<Source> **RF**
Radio Frequency ("RF INPUT" connector)
FIQ
I/Q data file
*RST: RF

Manual operation: See "Radio Frequency State" on page 48
See "I/Q File State" on page 49

8.4.3.2 Configuring the Outputs

Configuring trigger input/output is described in chapter 8.4.5.2, "Configuring the Trigger Output", on page 125.

DIAGnostic:SERVice:NSOurce 114

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the instrument in use on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 50

8.4.4 Frontend Configuration

The following commands are required to configure frequency and amplitude settings, which represent the "frontend" of the measurement setup.

- Frequency 114
- Amplitude Settings 116
- Configuring the Attenuation 117

8.4.4.1 Frequency

[SENSe:]FREQuency:CENTer 114
[SENSe:]FREQuency:CENTer:STEP 115
[SENSe:]FREQuency:CENTer:STEP:AUTO 115
[SENSe:]FREQuency:OFFSet 115

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

DOWN
Decreases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

*RST: fmax/2
Default unit: Hz

Example:

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Sets the center frequency to 110 MHz.

Usage: SCPI confirmed

Manual operation: See "Center frequency" on page 52

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 114.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency Stepsize" on page 53

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example:
```
FREQ:CENT:STEP:AUTO ON
```
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

See also "Frequency Offset" on page 53.

Parameters:

<Offset> Range: -100 GHz to 100 GHz
*RST: 0 Hz

Example:
```
FREQ:OFFS 1GHZ
```

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 53

8.4.4.2 Amplitude Settings

The following commands are required to configure the amplitude settings in a remote environment.

Useful commands for amplitude settings described elsewhere:

- `INPut:COUPling` on page 112
- `INPut:IMPedance` on page 113
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO` on page 190

Remote commands exclusive to amplitude settings:

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel 116
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet 116
INPut:GAIN:STATe 116
INPut:GAIN[:VALue] 117

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level (for all traces, <t> is irrelevant).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Parameters:

<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 54

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset (for all traces, <t> is irrelevant).

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Shifting the Display (Offset)" on page 54

INPut:GAIN:STATe <State>

This command turns the preamplifier on the instrument in use on and off. It requires the additional preamplifiier hardware option on the connected instrument.

Depending on the instrument in use, the preamplification is defined by `INPut:GAIN[:VALue]`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 56

INPut:GAIN[:VALue] <Gain>

This command selects the gain level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 116).

The command requires the additional preamplifier hardware option.

Parameters:

<Gain> 15 dB | 30 dB

The availability of gain levels depends on the model of the instrument in use.

*RST: OFF

Example: `INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Preamplifier" on page 56

8.4.4.3 Configuring the Attenuation

INPut:ATTenuation....117
INPut:ATTenuation:AUTO....118
INPut:EATT....118
INPut:EATT:AUTO....118
INPut:EATT:STATe....119

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>
Range: see data sheet
Increment: 5 dB
*RST: 10 dB (AUTO is set to ON)

Example: `INP:ATT 30dB`
Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 55

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S VSE determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:

<State>
ON | OFF | 0 | 1
*RST: 1

Example: `INP:ATT:AUTO ON`
Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual operation: See "Attenuation Mode / Value" on page 55

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 118).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:

<Attenuation>
attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual operation: See "Using Electronic Attenuation" on page 55

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation" on page 55

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:EATT:STAT ON`

Switches the electronic attenuator into the signal path.

Manual operation: See "Using Electronic Attenuation" on page 55

8.4.5 Triggering Measurements

Useful commands for triggering described elsewhere:

- `[SENSe:]FREQuency:CENTer` on page 114

Remote commands exclusive to triggering:

- Configuring the Triggering Conditions....119
- Configuring the Trigger Output....125

8.4.5.1 Configuring the Triggering Conditions

The following commands are required to configure triggered measurements.

Note that the availability of trigger settings depends on the instrument in use.

TRIGger[:SEQuence]:DTIMe....120
TRIGger[:SEQuence]:HOLDoff[:TIME]....120
TRIGger[:SEQuence]:IFPower:HOLDoff....120
TRIGger[:SEQuence]:IFPower:HYSTeresis....121
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]....121
TRIGger[:SEQuence]:LEVel:IFPower....121
TRIGger[:SEQuence]:LEVel:IQPower....122
TRIGger[:SEQuence]:LEVel:MAPower....122
TRIGger[:SEQuence]:MAPower:HOLDoff....122
TRIGger[:SEQuence]:MAPower:HYSTeresis....122
TRIGger[:SEQuence]:LEVel:RFPower....123
TRIGger[:SEQuence]:RFPower:HOLDoff....123

TRIGger[:SEQuence]:SLOPe 123
TRIGger[:SEQuence]:SOURce 123
TRIGger[:SEQuence]:TIME:RINTerval 124

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Drop-Out Time" on page 59

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the measurement.

A negative offset is possible for time domain measurements.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative measurement time to 30 s.

*RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 59

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 60

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis" on page 59

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Suffix:

<port> Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:

<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V

Example: `TRIG:LEV 2V`

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -10 dBm

Example: `TRIG:LEV:IFP -30DBM`

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm

Example: `TRIG:LEV:IQP -30DBM`

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

This command defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

Example: `TRIG:LEV:MAP -30DBM`

TRIGger[:SEQuence]:MAPower:HOLDoff <Period>

This command defines the holding time before the next trigger event for (offline) input from a file.

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s

Example: `TRIG:SOUR MAGN`
Sets an offline magnitude trigger source.
`TRIG:MAP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Holdoff" on page 60

TRIGger[:SEQuence]:MAPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: `TRIG:SOUR MAP`
Sets the (offline) magnitude trigger source.
`TRIG:MAP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Hysteresis" on page 59

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.

*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

Manual operation: See "Trigger Level" on page 58

TRIGger[:SEQuence]:RFPower:HOLDoff <Time>

This command defines the holding time before the next trigger event. Note that this command is available for any trigger source, not just RF Power.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 120 command for new remote control programs.

Parameters:

<Time> Default unit: S

TRIGger[:SEQuence]:SLOPe <Type>

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Slope" on page 59

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note that the availability of trigger sources depends on the instrument in use.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Parameters:

<Source>

IMMediate
Free Run

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding TRIGGER INPUT/ OUTPUT connector on the instrument in use, or the oscilloscope's corresponding input channel.
For details on the connectors see the instrument's Getting Started manual.

RFPower
First intermediate frequency

IFPower
Second intermediate frequency

IQPower
Magnitude of sampled I/Q data
For applications that process I/Q data, such as the I/Q Analyzer or optional applications.

MAGNitude
For (offline) input from a file, rather than an instrument. Triggers on a specified signal level.

*RST: IMMediate

Example:
```
TRIG:SOUR EXT
```
Selects the external trigger input as source of the trigger signal

Manual operation:
See "Trigger Source" on page 57
See "Free Run" on page 57
See "External Trigger<X>" on page 58
See "I/Q Power" on page 58
See "IF Power" on page 58
See "RF Power" on page 58

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval>

2.0 ms to 5000

Range: 2 ms to 5000 s
*RST: 1.0 s

Example:
```
TRIG:SOUR TIME
```
Selects the time trigger input for triggering.
```
TRIG:TIME:RINT 50
```
The measurement starts every 50 s.

Manual operation:
See "Repetition Interval" on page 59

8.4.5.2 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors on the instrument in use.

OUTPut:TRIGger<port>:DIRection....125
OUTPut:TRIGger<port>:LEVel....125
OUTPut:TRIGger<port>:OTYPe....125
OUTPut:TRIGger<port>:PULSe:IMMediate....126
OUTPut:TRIGger<port>:PULSe:LENGth....126

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction for trigger ports that serve as an input as well as an output.

Suffix:
<port>

Parameters:
<Direction>

INPut
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 50

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:
<port> Selects the trigger port to which the output is sent.

Parameters:
<Level>

HIGH
TTL signal.

LOW
0 V

*RST: LOW

Manual operation: See "Trigger 2/3" on page 50
See "Level" on page 51

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:
<port> Selects the trigger port to which the output is sent.

Parameters:
<OutputType> **DEVice**
Sends a trigger signal when the R&S VSE has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user defined trigger signal. For more information see `OUTPut:TRIGger<port>:LEVel`.

*RST: DEVice

Manual operation: See "Output Type" on page 51

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:
<port> Selects the trigger port to which the output is sent.

Usage: Event

Manual operation: See "Send Trigger" on page 51

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:
<port> Selects the trigger port to which the output is sent.

Parameters:
<Length> Pulse length in seconds.

Manual operation: See "Pulse Length" on page 51

8.4.6 Data Acquisition

The following commands are required to configure how much and how data is captured from the input signal.

[SENSe:]BANDwidth:DEMod 127
[SENSe:]BWIDth:DEMod 127
[SENSe:]BANDwidth|BWIDth:DEMod:TYPE 127
[SENSe:]SRATe? 127
[SENSe:]SWEep:TIME 127

[SENSe:]BANDwidth:DEMod <Bandwidth>
[SENSe:]BWIDth:DEMod <Bandwidth>

Sets/queries the measurement bandwidth in Hz.

The measurement bandwidth is defined by the used filter and the sample rate. For information on supported sample rates and filter bandwidths see the data sheet.

Parameters:
<Bandwidth> *RST: 80.0 MHz
Default unit: HZ

[SENSe:]BANDwidth|BWIDth:DEMod:TYPE <FilterType>

This command defines the type of demodulation filter to be used. For information on supported filter bandwidths see the data sheet.

Parameters:
<FilterType>

FLAT
Standard flat demodulation filter

GAUSs
Gaussian filter for optimized settling behaviour
For Gaussian filters with a large 3dB bandwidth (> 40 MHz, only available with the bandwidth extension option R&S VSE-B160/-B320/-B500) the actual filter shape deviates strongly from the ideal Gauss filter outside a range of approximately ±80 MHz. For this range the flat filter is more accurate.
For details see chapter A.4, "Effects of Large Gauss Filters", on page 262.

*RST: GAUS

Manual operation: See "Filter type" on page 61

[SENSe:]SRATe?

This command returns the sample rate set up for current measurement settings.

Return values:
<SampleRate> Current sample rate used by the application.

Usage: Query only

[SENSe:]SWEep:TIME <Time>

This command defines the measurement time.

The maximum measurement time in the R&S VSE Pulse application is limited only by the available memory ("memory limit reached" message is shown in status bar). Note, however, that increasing the measurement time (and thus reducing the available memory space) may restrict the number of measurement channels that can be activated simultaneously on the R&S VSE.

Parameters:

<Time> refer to data sheet

*RST: depends on current settings (determined automatically)

Example: `SWE:TIME 10s`

Usage: SCPI confirmed

Manual operation: See "Measurement Time" on page 62

8.4.7 Pulse Detection

The pulse detection settings define the conditions under which a pulse is detected within the input signal.

[SENSe:]DETect:LIMit 128
[SENSe:]DETect:LIMit:COUNt 128
[SENSe:]DETect:HYSTeresis 129
[SENSe:]DETect:REFerence 129
[SENSe:]DETect:THReshold 129

[SENSe:]DETect:LIMit <MaxCountLimit>

If enabled, the number of pulses to be detected is restricted. When the maximum number is exceeded, measurement is stopped for the current capture buffer. This limitation can be used to speed up the measurement if only a small number of pulses is of interest.

The maximum number of pulses to be detected is defined using the `[SENSe:]DETect:LIMit:COUNt` command.

Parameters:

<MaxCountLimit> ON | OFF

*RST: OFF

Manual operation: See "Detection Limit" on page 64

[SENSe:]DETect:LIMit:COUNt <MaxPulseCount>

Defines the maximum number of pulses to be detected.

This limit is only considered if `[SENSe:]DETect:LIMit` is enabled.

Parameters:

<MaxPulseCount> integer

*RST: 1000

Manual operation: See "Maximum Pulse Count" on page 64

[SENSe:]DETect:HYSTeresis <Hysteresis>

Defines a hysteresis for pulse detection in dB in relation to the defined threshold (see `[SENSe:]DETect:THReshold` on page 129). As long as the signal does not exceed the hysteresis, the next threshold crossing is ignored.

Parameters:

<Hysteresis> *RST: 0
Default unit: DB

Manual operation: See "Hysteresis" on page 64

[SENSe:]DETect:REFerence <Reference>

The reference level to be used for setting the pulse detection threshold.

Parameters:

<Reference> REFLevel | PEAK | NOISe | ABSolute

REFLevel
Current reference level

PEAK
Peak level as measured over the entire capture data interval

NOISe
Noise level determined from the current capture data according to `SENSe:TRACe:MEASurement:DEFine:DURation:MIN` on page 109.

ABSolute
Absolute level defined by `[SENSe:]DETect:THReshold` on page 129.

*RST: PEAK

Manual operation: See "Reference Source" on page 63

[SENSe:]DETect:THReshold <Level>

The threshold determines whether a pulse is detected or not. The top of a pulse must exceed the threshold in order to be detected. The threshold is defined in relation to the reference defined by `[SENSe:]DETect:REFerence`.

Parameters:

<Level> numeric value in dB or dBm, depending on reference type

*RST: -10.0

Manual operation: See "Threshold" on page 63

8.4.8 Configuring the Pulse Measurement

The following commands determine how much data is measured for each pulse, in relation to defined levels, points, or ranges.

- Measurement Levels....130
- Measurement Point....132
- Measurement Range....133

8.4.8.1 Measurement Levels

SENSe:TRACe:MEASurement:ALGorithm....130
SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT....130
SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP....130
SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop....131
SENSe:TRACe:MEASurement:DEFine:RIPPle....131
SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence....131
SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence....132
SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence....132

SENSe:TRACe:MEASurement:ALGorithm <Algorithm>

The measurement algorithm used for finding the pulse top and base levels.

Parameters:

<Algorithm>

MEAN
The arithmetic average of the measured values

MEDian
The level for which half the values lie above, the other half below in the histogram

PEAKpower
The peak power is used to detect the pulse top level.

*RST: MEDian

Manual operation: See "Measurement Algorithm" on page 66

SENSe:TRACe:MEASurement:DEFine:AMPLitude:UNIT <Unit>

Defines the unit of the pulse amplitude values, i.e. whether magnitude (V) or power (W, dBm) values are used to determine the threshold levels for fall and rise times.

Parameters:

<Unit> V | W | DBM

*RST: V

Manual operation: See "Reference Level Unit" on page 66

SENSe:TRACe:MEASurement:DEFine:BOUNdary:TOP <PulseInstant>

The boundary in percent of the pulse amplitude to either side of the pulse top (ON state). Used to determine the settling time, for example. Once the signal remains within the boundary, it is assumed to have settled.

Parameters:

<PulseInstant> percentage

Range: 0 to 100
*RST: 3

Manual operation: See "Boundary" on page 67

SENSe:TRACe:MEASurement:DEFine:COMPensate:ADRoop <State>

Determines whether the 100% value (from base to top) for the rise and fall time measurements is calculated from the Edges.

This allows you to consider a "droop" in the pulse top during the pulse measurements. If a droop is to be considered, the 100% value must be calculated separately for the rising and falling edges.

Parameters:

<State>

ON
The 100% value is measured separately for the rising and falling edges.

OFF
The 100% value is measured at the pulse center and used for all measurements.

*RST: ON

Manual operation: See "Position" on page 65

SENSe:TRACe:MEASurement:DEFine:RIPPle <Portion>

Determines portion of the pulse top which is used to measure the ripple.

Parameters:

<Portion> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Ripple Portion" on page 66

SENSe:TRACe:MEASurement:DEFine:TRANsition:HREFerence <QueryRange>

The upper threshold in percent of the pulse amplitude used to signify the end of a rising or beginning of a falling signal level.

Parameters:

<QueryRange> percentage

Range: 0 to 100
*RST: 90

Manual operation: See "High (Distal) Threshold" on page 66

SENSe:TRACe:MEASurement:DEFine:TRANsition:LREFerence <QueryRange>

The lower threshold in percent of the pulse amplitude used to signify the end of a falling or beginning of a rising signal level.

Parameters:

<QueryRange> percentage

Range: 0 to 100
*RST: 10

Manual operation: See "Low (Proximal) Threshold" on page 66

SENSe:TRACe:MEASurement:DEFine:TRANsition:REFerence <QueryRange>

The threshold in percent of the pulse amplitude used to signify the mid-transition level between pulse states.

Parameters:

<QueryRange> percentage

Range: 0 to 100
*RST: 50

Manual operation: See "Mid (Mesial) Threshold" on page 66

8.4.8.2 Measurement Point

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant 132
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow 132
SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence 133

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant <PulseInstant>

The time instant used for in-pulse measurements e.g. power, phase or frequency.

Parameters:

<PulseInstant> *RST: 0
Default unit: S

Manual operation: See "Offset" on page 68

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:AWINdow <PulseInstant>

The length of an averaging window centered on the Measurement Point.

Parameters:

<PulseInstant> Size of the window around the measurement point used for averaging

Range: 0 to 10000
*RST: 0.0
Default unit: s

Manual operation: See "Averaging Window" on page 68

SENSe:TRACe:MEASurement:DEFine:PULSe:INSTant:REFerence <Reference>

The reference point used for specifying the pulse time instant.

Parameters:

<Reference> RISE | CENTer | FALL

RISE
The measurement point is defined in reference to the rising edge (mid-level crossing).

CENTer
The measurement point is defined in reference to the center of the pulse (equal distance from the rising and falling mid-level crossings).

FALL
The measurement point is defined in reference to the falling edge (mid-level crossing).

*RST: CENTer

Manual operation: See "Measurement Point Reference" on page 67

8.4.8.3 Measurement Range

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth 133
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT 133
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt 134
SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence 134

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:LENGth <Length>

The estimation range length as a percentage of the pulse top length.

Parameters:

<Length> percentage

Range: 0 to 100
*RST: 75

Manual operation: See "Reference" on page 69

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:LEFT <OffsetLeft>

The offset in seconds from the pulse rising edge at which the estimation range begins.

Parameters:

<OffsetLeft> *RST: 0
Default unit: S

Manual operation: See "Reference" on page 69

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:OFFSet:RIGHt
<OffsetRight>

The offset in seconds from the pulse falling edge at which the estimation range ends.

Parameters:
<OffsetRight> *RST: 0
Default unit: S

Manual operation: See "Reference" on page 69

SENSe:TRACe:MEASurement:DEFine:PULSe:ESTimation:REFerence
<Reference>

Defines the reference for the measurement range definition. Depending on the selected reference type, an additional setting is available to define the range.

Parameters:
<Reference> CENTer | EDGE

CENTer
Defines a relative range around the center of the pulse. The range is defined by its **length** in percent of the pulse top.

EDGE
Defines the start and stop of the measurement range with respect to the pulse edges. The range is defined by a time **offset** from the middle of the **rising edge** and a time offset from the middle of the **falling edge**.

*RST: CENTer

Manual operation: See "Reference" on page 69

8.4.9 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

- Global Layout Commands....134
- Working with Windows in the Display....138
- General Window Commands....144

8.4.9.1 Global Layout Commands

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in chapter 8.4.9.2, "Working with Windows in the Display", on page 138 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]? 135
LAYout:GLOBal:CATalog[:WINDow]? 136
LAYout:GLOBal:IDENtify[:WINDow]? 137
LAYout:GLOBal:REMove[:WINDow] 137
LAYout:GLOBal:REPLace[:WINDow] 138

LAYout:GLOBal:ADD[:WINDow]?
<ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

This command adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Parameters:

<ExChanName> string
Name of an existing channel

<ExWinName> string
Name of the existing window within the <ExChanName> channel the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows use the `LAYout:GLOBal:IDENtify[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | TAB
Direction the new window is added relative to the existing window.
TAB
The new window is added as a new tab in the specified existing window.

<NewChanName> string
Name of the channel for which a new window is to be added.

<NewWinType> string
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAYout:GLOBal:ADD:WINDow? 'IQ Analyzer','1',RIGH,'IQ Analyzer2','FREQ'`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage: Query only

Table 8-1: <WindowType> parameter values for Pulse application

Parameter value	Window type
MCAPture	Magnitude Capture Buffer
MTABle	Marker Table
PDIStribution	Parameter Distribution
PFRequency	Pulse Frequency
PMAGnitude	Pulse Magnitude
PPHase	Pulse Phase
PPWrapped	Pulse phase, wrapped
PRESults	Pulse Results
PSPectrum	Parameter Spectrum
PSTatistics	Pulse Statistics
PTRend	Parameter Trend
RRSPectrum	Result Range Spectrum

LAYout:GLOBal:CATalog[:WINDow]?

This command queries the name and index of all active windows from top left to bottom right for each active channel. The result is a comma-separated list of values for each window, with the syntax:

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:GLOB:CAT?`
Result:
`IQ Analyzer: '1',1,'2',2`
`Analog Demod: '1',1,'4',4`
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).
For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

This command queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:
<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:
<WindowName> String containing the name of a window.

Return values:
<WindowIndex> Index number of the window.

Example: `LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example: `LAYout:GLOBal:IDENtify? 'IQ Analyzer','Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>,<WindowName>

This command removes a window from the display.

Parameters:
<ChannelName> String containing the name of the channel.

<WindowName> String containing the name of the window.

Usage: Event

LAYout:GLOBal:REPLace[:WINDow]
<ExChannelName>,<WindowName>,<NewChannelName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Parameters:

<ExChannelName> String containing the name of the channel in which a window is to be replaced. The channel name is displayed as the tab label for the measurement channel.

<WindowName> String containing the name of the existing window.
To determine the name and index of all active windows, use the `LAYout:GLOBal:CATalog[:WINDow]?` query.

<NewChannelName> String containing the name of the channel for which a new window will be created.

<WindowType> Type of result display you want to use in the existing window.
Note that the window type must be valid for the specified channel (<NewChannelName>).
See `LAYout:ADD[:WINDow]?` on page 139 for a list of available window types.

Example: `LAY:GLOB:REPL:WIND 'IQ Analyzer','1', 'AnalogDemod',MTAB`
Replaces the I/Q Analyzer result display in window 1 by a marker table for the AnalogDemod channel.

8.4.9.2 Working with Windows in the Display

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

To configure the layout of windows across measurement channels, use the chapter 8.4.9.1, "Global Layout Commands", on page 134.

LAYout:ADD[:WINDow]?....139
LAYout:CATalog[:WINDow]?....140
LAYout:IDENtify[:WINDow]?....141
LAYout:REMove[:WINDow]....141
LAYout:REPLace[:WINDow]....141
LAYout:WINDow<n>:ADD?....142

LAYout:WINDow<n>:IDENtify?....143
LAYout:WINDow<n>:REMove....143
LAYout:WINDow<n>:REPLace....143

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display in the active measurement channel.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:
```
LAY:ADD? '1',LEFT,MTAB
```
Result:
```
'2'
```
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 20
See "Marker Table" on page 21
See "Parameter Distribution" on page 22
See "Parameter Spectrum" on page 23
See "Parameter Trend" on page 23
See "Pulse Frequency" on page 25
See "Pulse Magnitude" on page 25
See "Pulse Phase" on page 26
See "Pulse Phase (Wrapped)" on page 27
See "Pulse Results" on page 28
See "Pulse Statistics" on page 30

For a detailed example see chapter 8.7, "Programming Example: Pulse Measurement", on page 247.

Table 8-2: <WindowType> parameter values for Pulse application

Parameter value	Window type
MCAPture	Magnitude Capture Buffer
MTABle	Marker Table
PDIStribution	Parameter Distribution
PFRequency	Pulse Frequency
PMAGnitude	Pulse Magnitude
PPHase	Pulse Phase
PPWrapped	Pulse phase, wrapped
PRESults	Pulse Results
PSPectrum	Parameter Spectrum
PSTatistics	Pulse Statistics
PTRend	Parameter Trend

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active measurement channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all measurement channels use the `LAYout:GLOBal:CATalog[:WINDow]?` command.

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active measurement channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different measurement channel use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:
<WindowName> String containing the name of a window.

Return values:
<WindowIndex> Index number of the window.

Example: `LAY:WIND:IDEN? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active measurement channel.

To remove a window for a different measurement channel use the `LAYout:GLOBal:REMove[:WINDow]` command.

Parameters:
<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active measurement channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active measurement channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 139 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added, as opposed to `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 139 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:ADD[:WINDow]?` command.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active measurement channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active measurement channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

To remove a window in a different measurement channel use the `LAYout:GLOBal:REMove[:WINDow]` command.

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active measurement channel.

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 139 for a list of available window types.
Note that the window type must be valid for the active measurement channel. To create a window for a different measurement channel use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

8.4.9.3 General Window Commands

The following commands are required to work with windows, independently of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay[:WINDow<n>]:SELect 144

DISPlay[:WINDow<n>]:SELect

This command sets the focus on the selected result display window.

This window is then the active window.

Example: `DISP:WIND1:SEL`
Sets the window 1 active.

Usage: Setting only

8.4.10 Configuring the Results

Some evaluation methods require or allow for additional settings to configure the result display.

- Selecting the Pulse 144
- Defining the Result Range 145
- Configuring a Parameter Distribution 147
- Configuring a Parameter Spectrum 152
- Configuring a Parameter Trend 157
- Configuring the Statistics and Parameter Tables 174
- Configuring Limit Checks 185
- Configuring the Y-Axis Scaling and Units 190

8.4.10.1 Selecting the Pulse

The pulse traces (frequency, magnitude and pulse vs. time) always display the trace for one specific pulse, namely the currently selected pulse. To select a pulse, use the following command:

SENSe:TRACe:MEASurement:DEFine:PULSe:SELected 145

SENSe:TRACe:MEASurement:DEFine:PULSe:SELected <PulseNumber>

Selects a particular pulse for which the traces, parameters and results are displayed, or queries the number of the selected pulse. The number of the current or all detected pulses can be queried using `[SENSe:]PULSe:NUMBer?` on page 209 or `[SENSe:]PULSe:ID?` on page 209.

Note that this command causes an error if no measurement results are available.

Parameters:

<PulseNumber> Range: 0 to number of detected pulses
*RST: 0

8.4.10.2 Defining the Result Range

The result range determines which data is displayed on the screen (see also "Measurement range vs result range" on page 11). This range applies to the pulse magnitude, frequency and phase vs time displays.

SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment 145
SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO 145
SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth 146
SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet 146
SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence 146

SENSe:TRACe:MEASurement:DEFine:RRANge:ALIGnment <Alignment>

Specifies the alignment with respect to the reference point used to define the result range.

Parameters:

<Alignment> LEFT | CENTer | RIGHt

LEFT
The result range starts at the pulse center or selected edge.

CENTer
The result range is centered around the pulse center or selected edge.

RIGHt
The result range ends at the pulse center or selected edge.

*RST: CENTer

Manual operation: See "Alignment" on page 73

SENSe:TRACe:MEASurement:DEFine:RRANge:AUTO <State>

If enabled, the result range length is determined automatically according to the width of the selected pulse (see `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 145).

Parameters for setting and query:

<State>

OFF
Switch the function off

ON
Switch the function on

ONCE
Execute the function once and then switch it off

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 69
See "Auto Scale Once (All)" on page 70
See "Automatic Range Scaling" on page 72

SENSe:TRACe:MEASurement:DEFine:RRANge:LENGth <Length>

The length of the pulse result range (in seconds).

Parameters:

<Length>

*RST: 30 us
Default unit: S

Manual operation: See "Length" on page 73

SENSe:TRACe:MEASurement:DEFine:RRANge:OFFSet <Offset>

The offset (in seconds) from the reference point at which the pulse result range is aligned.

Parameters:

<Offset>

*RST: 0
Default unit: S

Manual operation: See "Offset" on page 73

SENSe:TRACe:MEASurement:DEFine:RRANge:REFerence <Reference>

Specifies the reference point used to define the result range.

Parameters:

<Reference>

RISE | CENTer | FALL

RISE
The result range is defined in reference to the rising edge.

CENTer
The result range is defined in reference to the center of the pulse top.

FALL
The result range is defined in reference to the falling edge.

*RST: CENTer

Manual operation: See "Result Range Reference Point" on page 73

8.4.10.3 Configuring a Parameter Distribution

The parameter distribution evaluations allow you to visualize the number of occurrances for a specific parameter value within the current capture buffer. For each parameter distribution window you can configure which measured parameter is to be displayed.

CALCulate<n>:DISTribution:FREQuency....147
CALCulate<n>:DISTribution:LLINes[:STATe]....148
CALCulate<n>:DISTribution:NBINs....148
CALCulate<n>:DISTribution:PHASe....148
CALCulate<n>:DISTribution:POWer....149
CALCulate<n>:DISTribution:TIMing....151

CALCulate<n>:DISTribution:FREQuency <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurence
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

Manual operation: See "X-Axis" on page 75

CALCulate<n>:DISTribution:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Parameters:

<State> ON | OFF

*RST: ON

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 75

CALCulate<n>:DISTribution:NBINs <# bins>

This command sets the number of bins used to calculate the historgram

Parameters:

<# bins> Range: 1 to 1000

*RST: 100

Manual operation: See "Histogram Bins" on page 75

CALCulate<n>:DISTribution:PHASe <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Setting parameters:

<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurance
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:POWer <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Setting parameters:

<XAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurance
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

CALCulate<n>:DISTribution:TIMing <XAxis>, <YAxis>

Configures the Parameter Distribution result display.

Setting parameters:

<XAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<YAxis> COUNt | OCCurrence

Parameter to be displayed on the y-axis.

COUNt
Number of pulses in which the parameter value occurred.

OCCurance
Percentage of all measured pulses in which the parameter value occurred.

*RST: COUNt

Usage: Setting only

8.4.10.4 Configuring a Parameter Spectrum

The parameter spectrum evaluations allow you to visualize the spectrum of results for a specific parameter for all measured pulses within the current capture buffer. For each parameter spectrum window you can configure which measured parameter is to be displayed.

CALCulate<n>:PSPectrum:AUTO 152
CALCulate<n>:PSPectrum:BLOCksize 152
CALCulate<n>:PSPectrum:FREQuency 153
CALCulate<n>:PSPectrum:GTHReshold 153
CALCulate<n>:PSPectrum:MAXFrequency 153
CALCulate<n>:PSPectrum:PHASe 154
CALCulate<n>:PSPectrum:POWer 154
CALCulate<n>:PSPectrum:RBW? 156
CALCulate<n>:PSPectrum:STHReshold 156
CALCulate<n>:PSPectrum:TIMing 156
CALCulate<n>:PSPectrum:WINDow 157

CALCulate<n>:PSPectrum:AUTO <State>

Enables or disables automatic configuration for Parameter Spectrum displays. If enabled, the commands for individual settings are not available.

Parameters:
<State> ON | OFF

*RST: ON

Manual operation: See "Full Auto" on page 77

CALCulate<n>:PSPectrum:BLOCksize <BlockSize>

Defines the size of blocks used in spectrum calculation. The block size also determines the resulting RBW of the spectrum (see CALCulate<n>:PSPectrum:RBW? on page 156).

Parameters:

<BlockSize> powers of 2

Range: 8 to 100k
*RST: 1024

Manual operation: See "Block Size" on page 77

CALCulate<n>:PSPectrum:FREQuency <Param>

Configures the Parameter Spectrum result display.

Setting parameters:

<Param> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Manual operation: See "Parameter" on page 77

CALCulate<n>:PSPectrum:GTHReshold <Time>

Defines the minimum time that must pass before a gap is detected as such.

Parameters:

<Time> Range: minimum spacing between pulses to meas time
Default unit: S

Manual operation: See "Gap Threshold" on page 77

CALCulate<n>:PSPectrum:MAXFrequency <Span>

Defines the maximum frequency span for which the Spectrum is calculated. Internally, the span is limited by the number of possible interpolation samples (100 000).

Parameters:

<Span> Range: >0 to 1/10 of sample rate
Default unit: HZ

Manual operation: See "Maximum Frequency" on page 77

CALCulate<n>:PSPectrum:PHASe <Param>

Configures the Parameter Spectrum result display.

Setting parameters:

<Param> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

CALCulate<n>:PSPectrum:POWer <Param>

Configures the Parameter Spectrum result display.

Setting parameters:

<Param> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

CALCulate<n>:PSPectrum:RBW?

Queries the resulting resolution bandwidth for the spectrum. Depends on the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 152).

Return values:

<Resolution Bandwidth> Default unit: Hz

Usage: Query only

CALCulate<n>:PSPectrum:STHReshold <SectThreshold>

Defines the minimum section size. Sections that are smaller than the threshold are ignored and considered to be part of the detected gap.

Parameters:

<SectThreshold> Minimum section size as a percentage of the block size (see `CALCulate<n>:PSPectrum:BLOCksize` on page 152)

Range: 0 to 100
*RST: 50

Manual operation: See "Section Threshold" on page 77

CALCulate<n>:PSPectrum:TIMing <Param>

Configures the Parameter Spectrum result display.

Setting parameters:

<Param> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

CALCulate<n>:PSPectrum:WINDow <WindowType>

Defines the used FFT window type

Setting parameters:

<WindowType> RECTangle | BARTlett | HAMMming | HANNing | BLACkman

*RST: BLACkman

Manual operation: See "Window Type" on page 77

8.4.10.5 Configuring a Parameter Trend

The parameter trend evaluations allow you to visualize changes in a specific parameter for all measured pulses within the current capture buffer. For each parameter trend window you can configure which measured parameter is to be displayed.

CALCulate<n>:TRENd:FREQuency....158
CALCulate<n>:TRENd:FREQuency:X....159
CALCulate<n>:TRENd:FREQuency:Y....160

CALCulate<n>:TRENd:LLINes[:STATe]....161
CALCulate<n>:TRENd:PHASe....161
CALCulate<n>:TRENd:PHASe:X....163
CALCulate<n>:TRENd:PHASe:Y....164
CALCulate<n>:TRENd:POWer....165
CALCulate<n>:TRENd:POWer:X....167
CALCulate<n>:TRENd:POWer:Y....169
CALCulate<n>:TRENd:TIMing....171
CALCulate<n>:TRENd:TIMing:X....172
CALCulate<n>:TRENd:TIMing:Y....173

CALCulate<n>:TRENd:FREQuency <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 172)

`CALCulate<n>:TRENd:FREQuency:Y <YAxis>` (see `CALCulate<n>:TRENd:FREQuency:Y` on page 160)

Setting parameters:

<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 209). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

Manual operation: See "Y-Axis" on page 79
See "X-Axis" on page 79

CALCulate<n>:TRENd:FREQuency:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Setting parameters:

<XAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Example: `CALC2:TREN:FREQ:X PERR`

Usage: Setting only

Manual operation: See "X-Axis" on page 79

CALCulate<n>:TRENd:FREQuency:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Setting parameters:

<YAxis> POINt | PPFRequency | RERRor | PERRor | DEViation | CRATe

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

POINt
Frequency at measurement point

PPFRequency
Pulse-Pulse Frequency Difference

RERRor
Frequency Error (RMS)

PERRor
Frequency Error (Peak)

DEViation
Frequency Deviation

CRATe
Chirp Rate

*RST: POINt

Usage: Setting only

Manual operation: See "Y-Axis" on page 79

CALCulate<n>:TRENd:LLINes[:STATe] <State>

Hides or shows the limit lines in the selected Parameter Trend or Parameter Distribution result display.

Note that this function only has an effect on the visibility of the lines in the graphical displays, it does not affect the limit check in general or the display of the limit check results in the table displays.

Parameters:

<State> ON | OFF

*RST: ON

Usage: Setting only

Manual operation: See "Display Limit Lines" on page 75

CALCulate<n>:TRENd:PHASe <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 172)

`CALCulate<n>:TRENd:PHASe:Y <YAxis>` (see `CALCulate<n>:TRENd:PHASe:Y` on page 164)

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 209). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:PHASe:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Setting parameters:

<XAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Example: `CALC2:TREN:PHAS:X PERR`

Usage: Setting only

CALCulate<n>:TRENd:PHASe:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Setting parameters:

<YAxis> POINt | PPPHase | RERRor | PERRor | DEViation

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.4, "Phase Parameters", on page 19.

POINt
Pulse phase at measurement point

PPPHase
Pulse-Pulse Phase Difference

RERRor
Phase Error (RMS)

PERRor
Phase Error (Peak)

DEViation
Phase Deviation

*RST: POINt

Usage: Setting only

CALCulate<n>:TRENd:POWer <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 172)

`CALCulate<n>:TRENd:POWer:Y <YAxis>` (see `CALCulate<n>:TRENd:POWer:Y` on page 169)

Setting parameters:

<YAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.2, "Power/Amplitude Parameters", on page 15.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 209). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:POWer:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Setting parameters:

<XAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.2, "Power/Amplitude Parameters", on page 15.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Example: `CALC2:TREN:POW:X ODB`

Usage: Setting only

CALCulate<n>:TRENd:POWer:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Setting parameters:

<YAxis> TOP | BASE | AMPLitude | ON | AVG | MIN | MAX | PON | PAVG | PMIN | ADPercent | ADDB | RPERcent | RDB | OPERcent | ODB | POINt | PPRatio

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.2, "Power/Amplitude Parameters", on page 15.

TOP
Top Power

BASE
Base Power

AMPLitude
Pulse Amplitude

ON
Average ON Power

AVG
Average Tx Power

MIN
Minimum Power

MAX
Peak Power

PON
Peak-to-Avg ON Power Ratio

PAVG
Peak-to-Average Tx Power Ratio

PMIN
Peak-to-Min Power Ratio

ADPercent
Droop in %

ADDB
Droop in dB

RPERcent
Ripple in %

RDB
Ripple in dB

OPERcent
Overshoot in %

ODB
Overshoot in dB

POINt
Pulse power measured at measurement point

PPRatio
Pulse-to-Pulse Power Difference

*RST: TOP

Usage: Setting only

CALCulate<n>:TRENd:TIMing <YAxis>, <XAxis>

Configures the Parameter Trend result display for time trends. This command defines both x-axis and y-axis parameters in one step. It is equivalent to the two subsequent commands:

`CALCulate<n>:TRENd:TIMing:X TSTamp | PNUMber` (see `CALCulate<n>:TRENd:TIMing:X` on page 172)

`CALCulate<n>:TRENd:TIMing:Y <YAxis>` (see `CALCulate<n>:TRENd:TIMing:Y` on page 173)

Setting parameters:

<YAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 209). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Usage: Setting only

CALCulate<n>:TRENd:TIMing:X <XAxis>

Configures the x-axis of the Parameter Trend result display.

The y-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:Y` commands.

Setting parameters:

<XAxis> PNUMber | TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the x-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

PNUMber
The pulse numbers are represented on the x-axis (available numbers can be queried using `[SENSe:]PULSe:NUMBer?` on page 209). Intervals without pulses are not displayed.

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: PNUMber

Example: `CALC2:TREN:TIM:X DCYCle`

Usage: Setting only

CALCulate<n>:TRENd:TIMing:Y <YAxis>

Configures the y-axis of the Parameter Trend result display.

The x-axis is configured using the `CALCulate<n>:TRENd:<GroupName>:X` commands.

Setting parameters:

<YAxis> TSTamp | SETTling | RISE | FALL | PWIDth | OFF | DRATio | DCYCle | PRI | PRF

Pulse parameter to be displayed on the y-axis. For a description of the available parameters see chapter 3.1.1, "Timing Parameters", on page 12.

TSTamp
Timestamp

SETTling
Settling Time

RISE
Rise Time

FALL
Fall Time

PWIDth
Pulse Width (ON Time)

OFF
Off Time

DRATio
Duty Ratio

DCYCle
Duty Cycle (%)

PRI
Pulse Repetition Interval

PRF
Pulse Repetition Frequency (Hz)

*RST: RISE

Example: `CALC2:TREN:TIM:Y DCYCle`

Usage: Setting only

8.4.10.6 Configuring the Statistics and Parameter Tables

The following commands select which parameters are displayed in the Pulse Statistics and Pulse Results evaluation.

For details on the individual parameters see chapter 3.1, "Pulse Parameters", on page 11.

CALCulate<n>:TABLe:FREQuency:ALL[:STATe] 175
CALCulate<n>:TABLe:FREQuency:CRATe 176
CALCulate<n>:TABLe:FREQuency:DEViation 176
CALCulate<n>:TABLe:FREQuency:PERRor 176
CALCulate<n>:TABLe:FREQuency:POINt 176
CALCulate<n>:TABLe:FREQuency:PPFRequency 177
CALCulate<n>:TABLe:FREQuency:RERRor 177
CALCulate<n>:TABLe:PHASe:ALL[:STATe] 177

CALCulate<n>:TABLe:PHASe:DEViation 178
CALCulate<n>:TABLe:PHASe:PERRor 178
CALCulate<n>:TABLe:PHASe:POINt 178
CALCulate<n>:TABLe:PHASe:PPPHase 178
CALCulate<n>:TABLe:PHASe:RERRor 178
CALCulate<n>:TABLe:POWer:ADRoop:DB 179
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] 179
CALCulate<n>:TABLe:POWer:ALL[:STATe] 179
CALCulate<n>:TABLe:POWer:AMPLitude 179
CALCulate<n>:TABLe:POWer:AVG 179
CALCulate<n>:TABLe:POWer:BASE 180
CALCulate<n>:TABLe:POWer:MAX 180
CALCulate<n>:TABLe:POWer:MIN 180
CALCulate<n>:TABLe:POWer:ON 180
CALCulate<n>:TABLe:POWer:OVERshoot:DB 180
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] 181
CALCulate<n>:TABLe:POWer:PAVG 181
CALCulate<n>:TABLe:POWer:PMIN 181
CALCulate<n>:TABLe:POWer:POINt 181
CALCulate<n>:TABLe:POWer:PON 181
CALCulate<n>:TABLe:POWer:PPRatio 182
CALCulate<n>:TABLe:POWer:RIPPle:DB 182
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] 182
CALCulate<n>:TABLe:POWer:TOP 182
CALCulate<n>:TABLe:TIMing:ALL[:STATe] 182
CALCulate<n>:TABLe:TIMing:DCYCle 183
CALCulate<n>:TABLe:TIMing:DRATio 183
CALCulate<n>:TABLe:TIMing:FALL 183
CALCulate<n>:TABLe:TIMing:OFF 183
CALCulate<n>:TABLe:TIMing:PRF 184
CALCulate<n>:TABLe:TIMing:PRI 184
CALCulate<n>:TABLe:TIMing:PWIDth 184
CALCulate<n>:TABLe:TIMing:RISE 184
CALCulate<n>:TABLe:TIMing:SETTling 185
CALCulate<n>:TABLe:TIMing:TSTamp 185

CALCulate<n>:TABLe:FREQuency:ALL[:STATe] <Visibility>[, <Scaling>]

If enabled, all frequency parameters are included in the result tables.

Setting parameters:

<Visibility> ON | OFF

*RST: OFF

<Scaling> GHZ | MHZ | KHZ | HZ

Optional: Defines the unit in which the results are displayed.

Usage: Setting only

CALCulate<n>:TABLe:FREQuency:CRATe <Visibility>[, <Scaling>]

If enabled, the chirp rate (per µs) is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: MHZ

Manual operation: See "Chirp Rate" on page 19

CALCulate<n>:TABLe:FREQuency:DEViation <Visibility>[, <Scaling>]

If enabled, the frequency deviation is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Frequency Deviation" on page 18

CALCulate<n>:TABLe:FREQuency:PERRor <Visibility>[, <Scaling>]

If enabled, the peak frequency error is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Frequency Error (Peak)" on page 18

CALCulate<n>:TABLe:FREQuency:POINt <Visibility>[, <Scaling>]

If enabled, the frequency at the measurement point is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Frequency" on page 18

CALCulate<n>:TABLe:FREQuency:PPFRequency <Visibility>[, <Scaling>]

If enabled, the Pulse-Pulse Frequency Difference is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Pulse-Pulse Frequency Difference" on page 18

CALCulate<n>:TABLe:FREQuency:RERRor <Visibility>[, <Scaling>]

If enabled, the RMS frequency error is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Optional: Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Frequency Error (RMS)" on page 18

CALCulate<n>:TABLe:PHASe:ALL[:STATe] <Visibility>

If enabled, all phase parameters are included in the result tables.

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

Usage: Setting only

CALCulate<n>:TABLe:PHASe:DEViation <Visibility>

If enabled, the Phase Deviation is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Phase Deviation" on page 20

CALCulate<n>:TABLe:PHASe:PERRor <Visibility>

If enabled, the Phase Error (Peak) is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Phase Error (Peak)" on page 19

CALCulate<n>:TABLe:PHASe:POINt <Visibility>

If enabled, the phase at the measurement point is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Manual operation: See "Phase" on page 19

CALCulate<n>:TABLe:PHASe:PPPHase <Visibility>

If enabled, the Pulse-Pulse Phase Difference is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Pulse-Pulse Phase Difference" on page 19

CALCulate<n>:TABLe:PHASe:RERRor <Visibility>

If enabled, the Phase Error (RMS) is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Phase Error (RMS)" on page 19

CALCulate<n>:TABLe:POWer:ADRoop:DB <Visibility>

If enabled, the Droop in dB is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Droop" on page 16

CALCulate<n>:TABLe:POWer:ADRoop[:PERCent] <Visibility>

If enabled, the droop in percent is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Droop" on page 16

CALCulate<n>:TABLe:POWer:ALL[:STATe] <Visibility>

If enabled, all power parameters are included in the result tables.

Setting parameters:
<Visibility> ON | OFF
*RST: OFF

Usage: Setting only

CALCulate<n>:TABLe:POWer:AMPLitude <Visibility>

If enabled, the pulse amplitude is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Pulse Amplitude" on page 15

CALCulate<n>:TABLe:POWer:AVG <Visibility>

If enabled, the average Tx power is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Manual operation: See "Average Tx Power" on page 16

CALCulate<n>:TABLe:POWer:BASE <Visibility>

If enabled, the base power is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Base Power" on page 15

CALCulate<n>:TABLe:POWer:MAX <Visibility>

If enabled, the maximum Tx power is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Peak Power" on page 16

CALCulate<n>:TABLe:POWer:MIN <Visibility>

If enabled, the minimum Tx power is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Minimum Power" on page 16

CALCulate<n>:TABLe:POWer:ON <Visibility>

If enabled, the average ON power is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Manual operation: See "Average ON Power" on page 15

CALCulate<n>:TABLe:POWer:OVERshoot:DB <Visibility>

If enabled, the overshoot in dB is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Overshoot" on page 17

CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent] <Visibility>

If enabled, the overshoot in percent is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Overshoot" on page 17

CALCulate<n>:TABLe:POWer:PAVG <Visibility>

If enabled, the Peak-to-Average Tx Power Ratio is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:PMIN <Visibility>

If enabled, the Peak-to-Min Power Ratio is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Peak-to-Min Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:POINt <Visibility>

If enabled, the power at the measurement point is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Power (at Point)" on page 17

CALCulate<n>:TABLe:POWer:PON <Visibility>

If enabled, the Peak-to-Avg ON Power Ratio is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 16

CALCulate<n>:TABLe:POWer:PPRatio <Visibility>

If enabled, the Pulse-to-Pulse Power Difference

is included in the result tables.

Parameters:

<Visibility> ON | OFF

*RST: OFF

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 17

CALCulate<n>:TABLe:POWer:RIPPle:DB <Visibility>

If enabled, the ripple in dB is included in the result tables.

Parameters:

<Visibility> ON | OFF

*RST: OFF

Manual operation: See "Ripple" on page 17

CALCulate<n>:TABLe:POWer:RIPPle[:PERCent] <Visibility>

If enabled, the ripple in percent is included in the result tables.

Parameters:

<Visibility> ON | OFF

*RST: OFF

Manual operation: See "Ripple" on page 17

CALCulate<n>:TABLe:POWer:TOP <Visibility>

If enabled, the Top power is included in the result tables.

Parameters:

<Visibility> ON | OFF

*RST: OFF

Manual operation: See "Top Power" on page 15

CALCulate<n>:TABLe:TIMing:ALL[:STATe] <Visibility>[, <Scaling>]

If enabled, all timing parameters are included in the result tables.

Setting parameters:

<Visibility> ON | OFF

*RST: OFF

<Scaling> S | MS | US | NS

Optional: Defines the unit in which the results are displayed.

Usage: Setting only

CALCulate<n>:TABLe:TIMing:DCYCle <Visibility>

If enabled, the duty cycle (in %) is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Manual operation: See "Duty Cycle (%)" on page 14

CALCulate<n>:TABLe:TIMing:DRATio <Visibility>

If enabled, the duty ratio (in dB) is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Manual operation: See "Duty Ratio" on page 14

CALCulate<n>:TABLe:TIMing:FALL <Visibility>[, <Scaling>]

If enabled, the fall time is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual operation: See "Fall Time" on page 13

CALCulate<n>:TABLe:TIMing:OFF <Visibility>[, <Scaling>]

If enabled, the "OFF" time is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual operation: See "Off Time" on page 14

CALCulate<n>:TABLe:TIMing:PRF <Visibility>[, <Scaling>]

If enabled, the pulse repetition frequency is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> GHZ | MHZ | KHZ | HZ
Optional: Defines the unit in which the results are displayed.
*RST: KHZ

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 14

CALCulate<n>:TABLe:TIMing:PRI <Visibility>[, <Scaling>]

If enabled, the pulse repetition interval is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: US

Manual operation: See "Pulse Repetition Interval" on page 14

CALCulate<n>:TABLe:TIMing:PWIDth <Visibility>[, <Scaling>]

If enabled, the pulse width is included in the result tables.

Suffix:
<n> 1..n

Parameters:
<Visibility> ON | OFF
*RST: ON

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: US

Manual operation: See "Pulse Width (ON Time)" on page 13

CALCulate<n>:TABLe:TIMing:RISE <Visibility>[, <Scaling>]

If enabled, the rise time is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: ON

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: NS

Manual operation: See "Rise Time" on page 13

CALCulate<n>:TABLe:TIMing:SETTling <Visibility>[, <Scaling>]

If enabled, the settling time is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual operation: See "Settling Time" on page 13

CALCulate<n>:TABLe:TIMing:TSTamp <Visibility>[, <Scaling>]

If enabled, the timestamp is included in the result tables.

Parameters:
<Visibility> ON | OFF
*RST: OFF

Setting parameters:
<Scaling> S | MS | US | NS
Optional: Defines the unit in which the results are displayed.
*RST: MS

Manual operation: See "Timestamp" on page 13

8.4.10.7 Configuring Limit Checks

For each parameter in the result tables you can activate a limit check and define the valid value ranges. For details see "Pulse Results" on page 28.

Useful commands for configuring limit checks described elsewhere:

- `CALCulate<n>:DISTribution:LLINes[:STATe]` on page 148
- `CALCulate<n>:TRENd:LLINes[:STATe]` on page 161

Remote commands exclusive to configuring limit checks:

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe 187
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe 187
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe 187
CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe 187
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe 187
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe 188
CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:PON:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe 188
CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe 188
CALCulate<n>:TABLe:FREQuency:ALL:LIMit:STATe 188
CALCulate<n>:TABLe:PHASe:ALL:LIMit:STATe 188
CALCulate<n>:TABLe:POWer:ALL:LIMit:STATe 188
CALCulate<n>:TABLe:TIMing:ALL:LIMit:STATe 188
CALCulate<n>:TABLe:ALL:LIMit:STATe 189
CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit 189
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit 189

CALCulate<n>:TABLe:FREQuency:DEViation:LIMit 189
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit 189
CALCulate<n>:TABLe:FREQuency:POINt:LIMit 189
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit 189
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit 189
CALCulate<n>:TABLe:PHASe:DEViation:LIMit 189
CALCulate<n>:TABLe:PHASe:PERRor:LIMit 189
CALCulate<n>:TABLe:PHASe:POINt:LIMit 189
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit 189
CALCulate<n>:TABLe:PHASe:RERRor:LIMit 189
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit 189
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit 189
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit 189
CALCulate<n>:TABLe:POWer:AVG:LIMit 189
CALCulate<n>:TABLe:POWer:BASE:LIMit 189
CALCulate<n>:TABLe:POWer:MAX:LIMit 189
CALCulate<n>:TABLe:POWer:MIN:LIMit 189
CALCulate<n>:TABLe:POWer:ON:LIMit 189
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit 189
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit 189
CALCulate<n>:TABLe:POWer:PAVG:LIMit 189
CALCulate<n>:TABLe:POWer:PMIN:LIMit 189
CALCulate<n>:TABLe:POWer:POINt:LIMit 189
CALCulate<n>:TABLe:POWer:PON:LIMit 189
CALCulate<n>:TABLe:POWer:PPRatio:LIMit 189
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit 189
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit 189
CALCulate<n>:TABLe:POWer:TOP:LIMit 189
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit 189
CALCulate<n>:TABLe:TIMing:DRATio:LIMit 189
CALCulate<n>:TABLe:TIMing:FALL:LIMit 189
CALCulate<n>:TABLe:TIMing:OFF:LIMit 189
CALCulate<n>:TABLe:TIMing:PRF:LIMit 189
CALCulate<n>:TABLe:TIMing:PRI:LIMit 189
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit 189
CALCulate<n>:TABLe:TIMing:RISE:LIMit 190
CALCulate<n>:TABLe:TIMing:SETTling:LIMit 190
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit 190

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:POINt:LIMit:STATe <State>

CALCulate<n>:TABLe:PHASe:PPPHase:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:AVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:BASE:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MAX:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:MIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PAVG:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PMIN:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:POINt:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PON:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:TOP:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:FALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:OFF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRF:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PRI:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:RISE:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit:STATe <State>

Activates or deactivates a limit check for the selected parameter. The limits are defined using `CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit` on page 189.

Parameters:

<State> ON | OFF

*RST: OFF

CALCulate<n>:TABLe:<ParameterGroup>:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:FREQuency:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:PHASe:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:POWer:ALL:LIMit:STATe <State>
CALCulate<n>:TABLe:TIMing:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in the selected parameter group.

Parameters:

<State> ON | OFF

*RST: OFF

CALCulate<n>:TABLe:ALL:LIMit:STATe <State>

Activates or deactivates a limit check for all parameters in all parameter groups.

Parameters:

<State> ON | OFF
*RST: OFF

Manual operation: See "Deactivating all limit checks for all parameter groups" on page 83

CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:CRATe:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:DEViation:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:PERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:PPFRequency:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:FREQuency:RERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:DEViation:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:PERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:PPPHase:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:PHASe:RERRor:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ADRoop:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ADRoop[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:AMPLitude:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:AVG:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:BASE:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:MAX:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:MIN:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:ON:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:OVERshoot:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:OVERshoot[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PAVG:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PMIN:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:POINt:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PON:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:PPRatio:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:RIPPle:DB:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:RIPPle[:PERCent]:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:POWer:TOP:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:DCYCle:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:DRATio:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:FALL:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:OFF:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PRF:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PRI:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:PWIDth:LIMit <LowLimit>, <UppLimit>

CALCulate<n>:TABLe:TIMing:RISE:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:SETTling:LIMit <LowLimit>, <UppLimit>
CALCulate<n>:TABLe:TIMing:TSTamp:LIMit <LowLimit>, <UppLimit>

Defines the valid value range for the limit check for the selected parameter if limit check is active (`CALCulate<n>:TABLe:<ParameterGroup>:<Parameter>:LIMit:STATe ON`).

For details on the individual parameters see chapter 3.1, "Pulse Parameters", on page 11.

Parameters:

<LowLimit> Lower limit of the valid value range.
Default unit: S

<UppLimit> Upper limit of the valid value range.
Default unit: S

8.4.10.8 Configuring the Y-Axis Scaling and Units

The scaling for the vertical axis is highly configurable, using either absolute or relative values. These commands are described here.

Useful commands for configuring scaling described elsewhere:

- `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 116

Remote commands exclusive to scaling the y-axis

DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT? 190
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO 190
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum 191
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum 191
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision 192
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition 192
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue 192
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum 192
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum 193
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT? 193
UNIT:ANGLe 193

DISPlay[:WINDow<n>]:TRACe<t>:X[:SCALe]:UNIT?

This command reads the unit type currently configured for the X-axis

Usage: Query only

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO <State>

If enabled, the Y-axis is scaled automatically according to the current measurement.

Parameters for setting and query:

<State>

OFF
Switch the function off

ON
Switch the function on

ONCE
Execute the function once

*RST: ON

Manual operation: See "Auto Scale Continuous (All)" on page 69
See "Auto Scale Once (All)" on page 70
See "Automatic Grid Scaling" on page 84
See "Auto Scale Once" on page 85

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

This command defines the maximum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

Parameters:

<Value>

<numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 85

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

This command defines the minimum value of the y-axis for all traces in the selected result display.

The suffix <t> is irrelevant.

Parameters:

<Value>

<numeric value>

*RST: depends on the result display
The unit and range depend on the result display.

Example:

```
DISP:TRAC:Y:MIN -60
DISP:TRAC:Y:MAX 0
```

Defines the y-axis with a minimum value of -60 and maximum value of 0.

Manual operation: See "Absolute Scaling (Min/Max Values)" on page 85

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:PDIVision <Value>

This remote command determines the grid spacing on the Y-axis for all diagrams, where possible.

The suffix <t> is irrelevant.

Parameters:

<Value> numeric value WITHOUT UNIT (unit according to the result display)

Defines the range per division (total range = 10*<Value>)

*RST: depends on the result display

Example: `DISP:TRAC:Y:PDIV 10`
Sets the grid spacing to 10 units (e.g. dB) per division

Manual operation: See "Per Division" on page 85

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid (for all traces, <t> is irrelevant).

The R&S VSE adjusts the scaling of the y-axis accordingly.

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display

Example: `DISP:TRAC:Y:RPOS 50PCT`

Usage: SCPI confirmed

Manual operation: See "Ref Position" on page 85

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Parameters:

<Value> numeric value WITHOUT UNIT

Default unit: dBm

Manual operation: See "Ref Value" on page 85

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MAXimum <Value>

This command defines the maximum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

Parameters:

<Value> numeric value
Default unit: dBm

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:RVALue:MINimum <Value>

This command defines the minimum value on the y-axis for all traces in the specified window.

The suffix <t> is irrelevant.

Parameters:

<Value> numeric_value
Default unit: dBm

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:UNIT?

This command reads the unit type currently configured for the Y-axis

Usage: Query only

UNIT:ANGLe <Unit>

This command selects the unit for angles (for PM display).

This command is identical to `CALC:UNIT:ANGL`

Parameters:

<Unit> DEG | RAD
*RST: RAD

Example: `UNIT:ANGL DEG`

Manual operation: See "Phase Unit" on page 86

8.5 Analyzing Results

The following remote commands are required to configure general result analysis settings concerning the trace, markers, etc. in a remote environment.

More details are described for manual operation in chapter 6, "Analysis", on page 71.

- Configuring Standard Traces 194
- Working with Markers 197
- Zooming into the Display 204

8.5.1 Configuring Standard Traces

The following commands are required to configure traces in the R&S VSE Pulse application.

DISPlay[:WINDow<n>]:TRACe<t>:MODE....194
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous....194
[SENSe:]SWEep:COUNt....195
[SENSe:]AVERage<n>:COUNt....195
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]....195
[SENSe:]AVERage<n>[:STATe<t>]....195
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]....195
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO....196
[SENSe:][STATistic<n>:]TYPE....196
[SENSe:]SWEep:POINts....197

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

Example: `INIT:CONT OFF`
Switching to single sweep mode.
`SWE:COUN 16`
Sets the number of measurements to 16.
`DISP:TRAC3:MODE WRIT`
Selects clear/write mode for trace 3.
`INIT;*WAI`
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 94

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:
<State>
ON
The automatic reset is off.
OFF
The automatic reset is on.
*RST: OFF

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 94

[SENSe:]SWEep:COUNt <SweepCount>
[SENSe:]AVERage<n>:COUNt <AverageCount>

This command defines the number of measurements that the application uses to average traces (for all windows, <n> is irrelevant).

In case of continuous capture mode, the application calculates the moving average over the average count.

In case of single capture mode, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<AverageCount> If you set a average count of 0 or 1, the application performs one single measurement in single capture mode.
In continuous capture mode, if the average count is set to 0, a moving average over 10 measurements is performed.

Range: 0 to 200000
*RST: 0

Usage: SCPI confirmed

Manual operation: See "Capture / Average Count" on page 95

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4/Trace 5/Trace 6" on page 93
See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 96

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:

<State> ON | OFF

Usage: SCPI confirmed

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

SAMPle
First value detected per trace point

*RST: APEak (I/Q Analyzer: RMS)

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 94

[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 94

[SENSe:][STATistic<n>:]TYPE <TraceStatistic>

Defines which pulses are included in the statistical evaluation of traces in result displays based on the result range.

Parameters:

<TraceStatistic> SEL | ALL

SEL
Only the selected pulse from each capture is included in the statistical evaluation of trace results. The pulse is selected using `SENSe:TRACe:MEASurement:DEFine:PULSe:SELected` on page 145.

ALL
All measured pulses from each capture are included in the statistical evaluation of trace results.

Manual operation: See "Selected Pulse vs All Pulses" on page 95

[SENSe:]SWEep:POINts <Points>

Sets/queries the number of trace points to be displayed and used for statistical evaluation.

Parameters:
<Points>

Manual operation: See "Maximum number of trace points" on page 95

8.5.2 Working with Markers

- Individual Marker Settings....197
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8.5.2.1 Individual Marker Settings

CALCulate<n>:MARKer<m>:AOFF....197
CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m>....197
CALCulate<n>:MARKer<m>[:STATe]....198
CALCulate<n>:MARKer<m>:TRACe....198
CALCulate<n>:MARKer<m>:X....198
CALCulate<n>:DELTamarker<m>:AOFF....199
CALCulate<n>:DELTamarker<m>:LINK....199
CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m>....199
CALCulate<n>:DELTamarker<m>:MREF....199
CALCulate<n>:DELTamarker<m>[:STATe]....200
CALCulate<n>:DELTamarker<m>:TRACe....200
CALCulate<n>:DELTamarker<m>:X....200

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 90

CALCulate<n>:MARKer<m>:LINK:TO:MARKer<m> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88
See "Marker State" on page 89
See "Marker Type" on page 89

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:
<Trace>

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See "Assigning the Marker to a Trace" on page 89

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis. The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).
Range: The range depends on the current x-axis range.

Example: CALC:MARK2:X 1.7MHz
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 21
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88
See "X-value" on page 89

CALCulate<n>:DELTamarker<m>:AOFF

This command turns *all* delta markers off.

(<m> is irrelevant)

Example: CALC:DELT:AOFF
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:DELT2:LINK ON

CALCulate<n>:DELTamarker<m>:LINK:TO:MARKer<m> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:DELT4:LINK:TO:MARK2 ON
Links the delta marker 4 to the marker 2.

CALCulate<n>:DELTamarker<m>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

Parameters:
<Reference> **1 to 16**
Selects markers 1 to 16 as the reference.

Example: CALC:DELT3:MREF 2
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 89

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:DELT2 ON
Turns on delta marker 2.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88
See "Marker State" on page 89
See "Marker Type" on page 89

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Parameters:
<Trace> Trace number the marker is assigned to.

Example: CALC:DELT2:TRAC 2
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Parameters:
<Position> Numeric value that defines the marker position on the x-axis.
Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: CALC:DELT:X?
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88
See "X-value" on page 89

8.5.2.2 General Marker Settings

CALCulate<n>:MARKer<m>:LINK 201
DISPlay:MTABle 201

CALCulate<n>:MARKer<m>:LINK <State>

This command defines whether all markers within the selected result display are linked. If enabled, and you move one marker along the x-axis, all other markers in the display are moved to the same x-axis position.

(The suffix <m> is irrelevant.)

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC2:MARK:LINK ON`

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:
<DisplayMode> **ON**
Turns the marker table on.
OFF
Turns the marker table off.
AUTO
Turns the marker table on if 3 or more markers are active.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 91

8.5.2.3 Positioning Markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT 202
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT 202
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt 202
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] 202
CALCulate<n>:DELTamarker<m>:MINimum:LEFT 202
CALCulate<n>:DELTamarker<m>:MINimum:NEXT 203
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt 203

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] 203
CALCulate<n>:MARKer<m>:MAXimum:LEFT 203
CALCulate<n>:MARKer<m>:MAXimum:NEXT 203
CALCulate<n>:MARKer<m>:MAXimum:RIGHt 203
CALCulate<n>:MARKer<m>:MAXimum[:PEAK] 204
CALCulate<n>:MARKer<m>:MINimum:LEFT 204
CALCulate<n>:MARKer<m>:MINimum:NEXT 204
CALCulate<n>:MARKer<m>:MINimum:RIGHt 204
CALCulate<n>:MARKer<m>:MINimum[:PEAK] 204

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

Usage: Event

Manual operation: See "Search Next Peak" on page 92

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 91

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 92

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 92

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

Usage: Event

Manual operation: See "Search Next Peak" on page 92

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Peak Search" on page 91

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

Usage: Event

Manual operation: See "Search Next Minimum" on page 92

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

Usage: Event

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

If the marker is not yet active, the command first activates the marker.

Usage: Event

Manual operation: See "Search Minimum" on page 92

8.5.3 Zooming into the Display

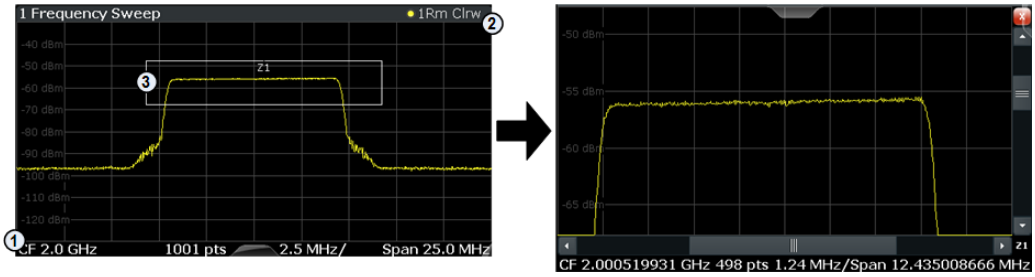
8.5.3.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA 205
DISPlay[:WINDow<n>]:ZOOM:STATe 205

DISPlay[:WINDow<n>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Parameters:

<x1>,<y1>,
<x2>,<y2>

Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 98

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State>

ON | OFF

*RST: OFF

Example:

```
DISP:ZOOM ON
```

Activates the zoom mode.

Manual operation: See "Single Zoom" on page 98
See "Restore Original Display" on page 98
See "Deactivating Zoom (Selection mode)" on page 98

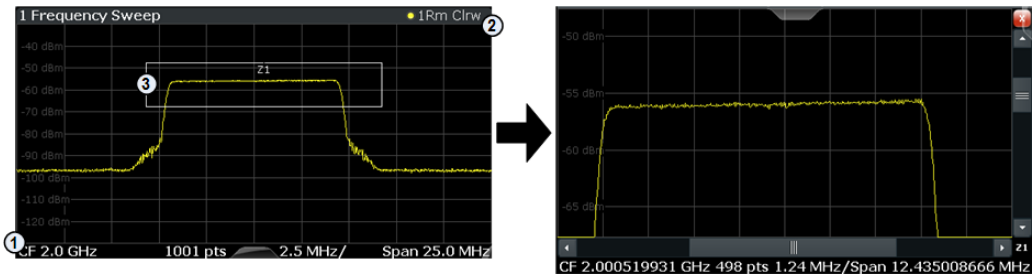
8.5.3.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....205
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....206

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<zoom> 1...4
Selects the zoom window.

Parameters:

<x1>,<y1>, <x2>,<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.

Range: 0 to 100
Default unit: PCT

Manual operation: See "Multiple Zoom" on page 98

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:

<zoom> 1...4
Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Multiple Zoom" on page 98
See "Restore Original Display" on page 98
See "Deactivating Zoom (Selection mode)" on page 98

8.6 Retrieving Results

The following remote commands are required to retrieve the results from a Pulsemeasurement in a remote environment.

- Retrieving Results.....207
- Retrieving Marker Results.....245

8.6.1 Retrieving Results

The following commands are required to retrieve the calculated pulse parameters.

Note that for each pulse result query you can specify for which pulse(s) you require results:

- **ALL**: for all pulses detected in the entire measurement
- **CURRent**: for all pulses in the current capture buffer
- **SELected**: only for the currently selected pulse

For each pulse result, you can query either the current value (default) or the following statistical values for the pulses detected in the capture buffer or the entire measurement:

- **AVER:** average of the results
- **MIN:** minimum of the results
- **MAX:** maximum of the results
- **SDEV:** standard deviation of the results

- Retrieving and Storing Trace Data....207
- Retrieving Information on Detected Pulses....209
- Retrieving Parameter Results....209
- Exporting Trace Results to an ASCII File....242
- Exporting Table Results to an ASCII File....244

8.6.1.1 Retrieving and Storing Trace Data

In order to retrieve the trace results in a remote environment, use the following command:

TRACe<n>[:DATA]? <Trace>

This command queries the y-values in the selected result display. It is only available for graphical displays.

For each trace point, the measured or calculated value is returned. For the Magnitude Capture display, the maximum y-value for each trace point is returned.

The unit depends on the display and on the unit you have currently set.

Query parameters:

<Trace> TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

The trace number whose values are to be returned.

Usage: Query only

Manual operation: See "Magnitude Capture" on page 20
See "Parameter Distribution" on page 22
See "Parameter Spectrum" on page 23
See "Pulse Frequency" on page 25
See "Pulse Magnitude" on page 25
See "Pulse Phase" on page 26
See "Pulse Phase (Wrapped)" on page 27

TRACe<n>[:DATA]:X? <Trace>

This remote control command returns the X values only for the trace in the selected result display. Depending on the type of result display and the scaling of the x-axis, this can be either the pulse number or a timestamp for each detected pulse in the capture buffer.

This command is only available for graphical displays, except for the Magnitude Capture display.

Query parameters:

<Trace> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6
The trace number whose values are to be returned.

Example: See chapter 8.7, "Programming Example: Pulse Measurement", on page 247.

Usage: Query only

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

For details on the file format see chapter A.3, "Reference: ASCII File Export Format", on page 261.

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'C:\TEST.ASC'`
Stores trace 3 from window 1 in the file `TEST.ASC`.

Example: See chapter 8.7, "Programming Example: Pulse Measurement", on page 247.

Usage: SCPI confirmed

Manual operation: See "Export Trace to ASCII File" on page 97

8.6.1.2 Retrieving Information on Detected Pulses

The following commands return general information on the currently selected or all detected pulses.

[SENSe:]PULSe:ID?....209
[SENSe:]PULSe:NUMBer?....209

[SENSe:]PULSe:ID? <QueryRange>

Queries the ids of the detected pulses, i.e the unique index within the entire measurement (as opposed to `[SENSe:]PULSe:NUMBer?`).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:NUMBer? <QueryRange>

Queries the detected pulse numbers, i.e. the index within the capture buffer (as opposed to `[SENSe:]PULSe:ID?`).

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

8.6.1.3 Retrieving Parameter Results

The following commands return the calculated pulse parameters.

For details on the individual parameters see chapter 3.1.2, "Power/Amplitude Parameters", on page 15.

- Retrieving Power / Amplitude Parameters....209
- Retrieving Timing Parameters....224
- Retrieving Frequency Parameters....231
- Retrieving Phase Parameters....236
- Commands for Compatibility....240

Retrieving Power / Amplitude Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see chapter 3.1.2, "Power/Amplitude Parameters", on page 15.

[SENSe:]PULSe:POWer:ADRoop:DB?....211
[SENSe:]PULSe:POWer:ADRoop:DB:AVERage?....212
[SENSe:]PULSe:POWer:ADRoop:DB:MAXimum?....212
[SENSe:]PULSe:POWer:ADRoop:DB:MINimum?....212
[SENSe:]PULSe:POWer:ADRoop:DB:SDEViation?....212
[SENSe:]PULSe:POWer:ADRoop[:PERCent]?....212
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:AVERage?....212
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MAXimum?....212
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MINimum?....213
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:SDEViation?....213
[SENSe:]PULSe:POWer:AMPLitude?....213
[SENSe:]PULSe:POWer:AMPLitude:AVERage?....213
[SENSe:]PULSe:POWer:AMPLitude:MAXimum?....213
[SENSe:]PULSe:POWer:AMPLitude:MINimum?....213
[SENSe:]PULSe:POWer:AMPLitude:SDEViation?....213
[SENSe:]PULSe:POWer:AVG?....213
[SENSe:]PULSe:POWer:AVG:AVERage?....214
[SENSe:]PULSe:POWer:AVG:MAXimum?....214
[SENSe:]PULSe:POWer:AVG:MINimum?....214
[SENSe:]PULSe:POWer:AVG:SDEViation?....214
[SENSe:]PULSe:POWer:BASE?....214
[SENSe:]PULSe:POWer:BASE:AVERage?....214
[SENSe:]PULSe:POWer:BASE:MAXimum?....214
[SENSe:]PULSe:POWer:BASE:MINimum?....215
[SENSe:]PULSe:POWer:BASE:SDEViation?....215
[SENSe:]PULSe:POWer:MAX?....215
[SENSe:]PULSe:POWer:MAX:AVERage?....215
[SENSe:]PULSe:POWer:MAX:MAXimum?....215
[SENSe:]PULSe:POWer:MAX:MINimum?....215
[SENSe:]PULSe:POWer:MAX:SDEViation?....215
[SENSe:]PULSe:POWer:MIN?....215
[SENSe:]PULSe:POWer:MIN:AVERage?....216
[SENSe:]PULSe:POWer:MIN:MAXimum?....216
[SENSe:]PULSe:POWer:MIN:MINimum?....216
[SENSe:]PULSe:POWer:MIN:SDEViation?....216
[SENSe:]PULSe:POWer:ON?....216
[SENSe:]PULSe:POWer:ON:AVERage?....216
[SENSe:]PULSe:POWer:ON:MAXimum?....216
[SENSe:]PULSe:POWer:ON:MINimum?....217
[SENSe:]PULSe:POWer:ON:SDEViation?....217
[SENSe:]PULSe:POWer:OVERshoot:DB?....217
[SENSe:]PULSe:POWer:OVERshoot:DB:AVERage?....217
[SENSe:]PULSe:POWer:OVERshoot:DB:MAXimum?....217
[SENSe:]PULSe:POWer:OVERshoot:DB:MINimum?....217
[SENSe:]PULSe:POWer:OVERshoot:DB:SDEViation?....217
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]?....217
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:AVERage?....218

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MAXimum? 218
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MINimum? 218
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:SDEViation? 218
[SENSe:]PULSe:POWer:PAVG? 218
[SENSe:]PULSe:POWer:PAVG:AVERage? 218
[SENSe:]PULSe:POWer:PAVG:MAXimum? 218
[SENSe:]PULSe:POWer:PAVG:MINimum? 219
[SENSe:]PULSe:POWer:PAVG:SDEViation? 219
[SENSe:]PULSe:POWer:PMIN? 219
[SENSe:]PULSe:POWer:PMIN:AVERage? 219
[SENSe:]PULSe:POWer:PMIN:MAXimum? 219
[SENSe:]PULSe:POWer:PMIN:MINimum? 219
[SENSe:]PULSe:POWer:PMIN:SDEViation? 219
[SENSe:]PULSe:POWer:POINt? 219
[SENSe:]PULSe:POWer:POINt:AVERage? 220
[SENSe:]PULSe:POWer:POINt:MAXimum? 220
[SENSe:]PULSe:POWer:POINt:MINimum? 220
[SENSe:]PULSe:POWer:POINt:SDEViation? 220
[SENSe:]PULSe:POWer:PON? 220
[SENSe:]PULSe:POWer:PON:AVERage? 220
[SENSe:]PULSe:POWer:PON:MAXimum? 220
[SENSe:]PULSe:POWer:PON:MINimum? 221
[SENSe:]PULSe:POWer:PON:SDEViation? 221
[SENSe:]PULSe:POWer:PPRatio? 221
[SENSe:]PULSe:POWer:PPRatio:AVERage? 221
[SENSe:]PULSe:POWer:PPRatio:MAXimum? 221
[SENSe:]PULSe:POWer:PPRatio:MINimum? 221
[SENSe:]PULSe:POWer:PPRatio:SDEViation? 221
[SENSe:]PULSe:POWer:RIPPle:DB? 222
[SENSe:]PULSe:POWer:RIPPle:DB:AVERage? 222
[SENSe:]PULSe:POWer:RIPPle:DB:MAXimum? 222
[SENSe:]PULSe:POWer:RIPPle:DB:MINimum? 222
[SENSe:]PULSe:POWer:RIPPle:DB:SDEViation? 222
[SENSe:]PULSe:POWer:RIPPle[:PERCent]? 222
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:AVERage? 223
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MAXimum? 223
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MINimum? 223
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:SDEViation? 223
[SENSe:]PULSe:POWer:TOP? 223
[SENSe:]PULSe:POWer:TOP:AVERage? 223
[SENSe:]PULSe:POWer:TOP:MAXimum? 223
[SENSe:]PULSe:POWer:TOP:MINimum? 223
[SENSe:]PULSe:POWer:TOP:SDEViation? 223

[SENSe:]PULSe:POWer:ADRoop:DB? <QueryRange>

Returns the amplitude droop in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Droop" on page 16

[SENSe:]PULSe:POWer:ADRoop:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop:DB:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:ADRoop[:PERCent]? <QueryRange>

Returns the amplitude droop in percent for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Droop" on page 16

[SENSe:]PULSe:POWer:ADRoop[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:ADRoop[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ADRoop[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the amplitude droop in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AMPLitude? <QueryRange>

Returns the pulse amplitude for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse Amplitude" on page 15

[SENSe:]PULSe:POWer:AMPLitude:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AMPLitude:SDEViation? <QueryRange>

Returns the statistical value for the pule amplitude over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:AVG? <QueryRange>

Returns the average transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Average Tx Power" on page 16

[SENSe:]PULSe:POWer:AVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:AVG:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:AVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:AVG:SDEViation? <QueryRange>

Returns the statistical value for the average transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:BASE? <QueryRange>

Returns the base power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Base Power" on page 15

[SENSe:]PULSe:POWer:BASE:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:BASE:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:BASE:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:BASE:SDEViation? <QueryRange>

Returns the statistical value for the base power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:MAX? <QueryRange>

Returns the maximum transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak Power" on page 16

[SENSe:]PULSe:POWer:MAX:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MAX:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:MAX:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MAX:SDEViation? <QueryRange>

Returns the statistical value for the maximum transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:MIN? <QueryRange>

Returns the minimum transmission power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Minimum Power" on page 16

[SENSe:]PULSe:POWer:MIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:MIN:SDEViation? <QueryRange>

Returns the statistical value for the minimum transmission power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:ON? <QueryRange>

Returns the average ON power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Average ON Power" on page 15

[SENSe:]PULSe:POWer:ON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:ON:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:ON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:ON:SDEViation? <QueryRange>

Returns the statistical value for the average ON power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot:DB? <QueryRange>

Returns the overshoot in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Overshoot" on page 17

[SENSe:]PULSe:POWer:OVERshoot:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot:DB:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]? <QueryRange>

Returns the overshoot in percent for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Overshoot" on page 17

[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:OVERshoot[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the overshoot in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:PAVG? <QueryRange>

Returns the Peak-to-Average Tx Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak-to-Average Tx Power Ratio" on page 16

[SENSe:]PULSe:POWer:PAVG:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:PAVG:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PAVG:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Average Tx Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:PMIN? <QueryRange>

Returns the Peak-to-Min Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak-to-Min Power Ratio" on page 16

[SENSe:]PULSe:POWer:PMIN:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PMIN:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Min Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:POINt? <QueryRange>

Returns the power in the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Power (at Point)" on page 17

[SENSe:]PULSe:POWer:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:POINt:SDEViation? <QueryRange>

Returns the statistical value for the power in the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:PON? <QueryRange>

Returns the Peak-to-Avg ON Power Ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Peak-to-Avg ON Power Ratio" on page 16

[SENSe:]PULSe:POWer:PON:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PON:MAXimum? <QueryRange>

[SENSe:]PULSe:POWer:PON:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PON:SDEViation? <QueryRange>

Returns the statistical value for the Peak-to-Avg ON Power Ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:PPRatio? <QueryRange>

Returns the Pulse-to-Pulse Power Difference for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse-to-Pulse Power Ratio" on page 17

[SENSe:]PULSe:POWer:PPRatio:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:PPRatio:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-to-Pulse Power Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle:DB? <QueryRange>

Returns the ripple in dB for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Ripple" on page 17

[SENSe:]PULSe:POWer:RIPPle:DB:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle:DB:SDEViation? <QueryRange>

Returns the statistical value for the ripple in dB over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:RIPPle[:PERCent]? <QueryRange>

Returns the ripple in percent for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Ripple" on page 17

[SENSe:]PULSe:POWer:RIPPle[:PERCent]:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:RIPPle[:PERCent]:SDEViation? <QueryRange>

Returns the statistical value for the ripple in percent over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:POWer:TOP? <QueryRange>

Returns the Top power for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Top Power" on page 15

[SENSe:]PULSe:POWer:TOP:AVERage? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MAXimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:MINimum? <QueryRange>
[SENSe:]PULSe:POWer:TOP:SDEViation? <QueryRange>

Returns the statistical value for the Top power over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Retrieving Timing Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see chapter 3.1.1, "Timing Parameters", on page 12.

[SENSe:]PULSe:TIMing:DCYCle? 225
[SENSe:]PULSe:TIMing:DCYCle:AVERage? 225
[SENSe:]PULSe:TIMing:DCYCle:MAXimum? 225
[SENSe:]PULSe:TIMing:DCYCle:MINimum? 225
[SENSe:]PULSe:TIMing:DCYCle:SDEViation? 225
[SENSe:]PULSe:TIMing:DRATio? 225
[SENSe:]PULSe:TIMing:DRATio:AVERage? 226
[SENSe:]PULSe:TIMing:DRATio:MAXimum? 226
[SENSe:]PULSe:TIMing:DRATio:MINimum? 226
[SENSe:]PULSe:TIMing:DRATio:SDEViation? 226
[SENSe:]PULSe:TIMing:FALL? 226
[SENSe:]PULSe:TIMing:FALL:AVERage? 226
[SENSe:]PULSe:TIMing:FALL:MAXimum? 226
[SENSe:]PULSe:TIMing:FALL:MINimum? 227
[SENSe:]PULSe:TIMing:FALL:SDEViation? 227
[SENSe:]PULSe:TIMing:OFF? 227
[SENSe:]PULSe:TIMing:OFF:AVERage? 227
[SENSe:]PULSe:TIMing:OFF:MAXimum? 227
[SENSe:]PULSe:TIMing:OFF:MINimum? 227
[SENSe:]PULSe:TIMing:OFF:SDEViation? 227
[SENSe:]PULSe:TIMing:PRF? 227
[SENSe:]PULSe:TIMing:PRF:AVERage? 228
[SENSe:]PULSe:TIMing:PRF:MAXimum? 228
[SENSe:]PULSe:TIMing:PRF:MINimum? 228
[SENSe:]PULSe:TIMing:PRF:SDEViation? 228
[SENSe:]PULSe:TIMing:PRI? 228
[SENSe:]PULSe:TIMing:PRI:AVERage? 228
[SENSe:]PULSe:TIMing:PRI:MAXimum? 228
[SENSe:]PULSe:TIMing:PRI:MINimum? 229
[SENSe:]PULSe:TIMing:PRI:SDEViation? 229
[SENSe:]PULSe:TIMing:PWIDth? 229
[SENSe:]PULSe:TIMing:PWIDth:AVERage? 229
[SENSe:]PULSe:TIMing:PWIDth:MAXimum? 229
[SENSe:]PULSe:TIMing:PWIDth:MINimum? 229
[SENSe:]PULSe:TIMing:PWIDth:SDEViation? 229
[SENSe:]PULSe:TIMing:RISE? 229
[SENSe:]PULSe:TIMing:RISE:AVERage? 230
[SENSe:]PULSe:TIMing:RISE:MAXimum? 230
[SENSe:]PULSe:TIMing:RISE:MINimum? 230
[SENSe:]PULSe:TIMing:RISE:SDEViation? 230
[SENSe:]PULSe:TIMing:SETTling? 230
[SENSe:]PULSe:TIMing:SETTling:AVERage? 230
[SENSe:]PULSe:TIMing:SETTling:MAXimum? 230
[SENSe:]PULSe:TIMing:SETTling:MINimum? 231

[SENSe:]PULSe:TIMing:SETTling:SDEViation? 231
[SENSe:]PULSe:TIMing:TSTamp? 231
[SENSe:]PULSe:TIMing:TSTamp:AVERage? 231
[SENSe:]PULSe:TIMing:TSTamp:MAXimum? 231
[SENSe:]PULSe:TIMing:TSTamp:MINimum? 231
[SENSe:]PULSe:TIMing:TSTamp:SDEViation? 231

[SENSe:]PULSe:TIMing:DCYCle? <QueryRange>

Returns the duty cycle (in %) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Duty Cycle (%)" on page 14

[SENSe:]PULSe:TIMing:DCYCle:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DCYCle:SDEViation? <QueryRange>

Returns the statistical value for the duty cycle (in %) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:DRATio? <QueryRange>

Returns the duty ratio for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Duty Ratio" on page 14

[SENSe:]PULSe:TIMing:DRATio:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:DRATio:SDEViation? <QueryRange>

Returns the statistical value for the duty ratio over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:FALL? <QueryRange>

Returns the fall time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Fall Time" on page 13

[SENSe:]PULSe:TIMing:FALL:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:MAXimum? <QueryRange>

[SENSe:]PULSe:TIMing:FALL:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:FALL:SDEViation? <QueryRange>

Returns the statistical value for the fall time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:OFF? <QueryRange>

Returns the Off time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Off Time" on page 14

[SENSe:]PULSe:TIMing:OFF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:OFF:SDEViation? <QueryRange>

Returns the statistical value for the Off time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:PRF? <QueryRange>

Returns the Pulse Repetition Frequency (Hz) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse Repetition Frequency (Hz)" on page 14

[SENSe:]PULSe:TIMing:PRF:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRF:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Frequency (Hz) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:PRI? <QueryRange>

Returns the Pulse Repetition Interval for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse Repetition Interval" on page 14

[SENSe:]PULSe:TIMing:PRI:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:MAXimum? <QueryRange>

[SENSe:]PULSe:TIMing:PRI:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PRI:SDEViation? <QueryRange>

Returns the statistical value for the Pulse Repetition Interval over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:PWIDth? <QueryRange>

Returns the pulse width for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse Width (ON Time)" on page 13

[SENSe:]PULSe:TIMing:PWIDth:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:PWIDth:SDEViation? <QueryRange>

Returns the pulse width for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:RISE? <QueryRange>

Returns the rise time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Rise Time" on page 13

[SENSe:]PULSe:TIMing:RISE:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:RISE:SDEViation? <QueryRange>

Returns the statistical value for the rise time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:SETTling? <QueryRange>

Returns the settling time for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Settling Time" on page 13

[SENSe:]PULSe:TIMing:SETTling:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:MAXimum? <QueryRange>

[SENSe:]PULSe:TIMing:SETTling:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:SETTling:SDEViation? <QueryRange>

Returns the statistical value for the settling time over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:TIMing:TSTamp? <QueryRange>

Returns the timestamp for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Timestamp" on page 13

[SENSe:]PULSe:TIMing:TSTamp:AVERage? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MAXimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:MINimum? <QueryRange>
[SENSe:]PULSe:TIMing:TSTamp:SDEViation? <QueryRange>

Returns the timestamp for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Retrieving Frequency Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see chapter 3.1.3, "Frequency Parameters", on page 18.

[SENSe:]PULSe:FREQuency:CRATe?....232
[SENSe:]PULSe:FREQuency:CRATe:AVERage?....233
[SENSe:]PULSe:FREQuency:CRATe:MAXimum?....233
[SENSe:]PULSe:FREQuency:CRATe:MINimum?....233
[SENSe:]PULSe:FREQuency:CRATe:SDEViation?....233
[SENSe:]PULSe:FREQuency:DEViation?....233
[SENSe:]PULSe:FREQuency:DEViation:AVERage?....233
[SENSe:]PULSe:FREQuency:DEViation:MAXimum?....233
[SENSe:]PULSe:FREQuency:DEViation:MINimum?....233
[SENSe:]PULSe:FREQuency:DEViation:SDEViation?....233
[SENSe:]PULSe:FREQuency:PERRor?....234
[SENSe:]PULSe:FREQuency:PERRor:AVERage?....234
[SENSe:]PULSe:FREQuency:PERRor:MAXimum?....234
[SENSe:]PULSe:FREQuency:PERRor:MINimum?....234
[SENSe:]PULSe:FREQuency:PERRor:SDEViation?....234
[SENSe:]PULSe:FREQuency:POINt?....234
[SENSe:]PULSe:FREQuency:POINt:AVERage?....235
[SENSe:]PULSe:FREQuency:POINt:MAXimum?....235
[SENSe:]PULSe:FREQuency:POINt:MINimum?....235
[SENSe:]PULSe:FREQuency:POINt:SDEViation?....235
[SENSe:]PULSe:FREQuency:PPFRequency?....235
[SENSe:]PULSe:FREQuency:PPFRequency:AVERage?....235
[SENSe:]PULSe:FREQuency:PPFRequency:MAXimum?....235
[SENSe:]PULSe:FREQuency:PPFRequency:MINimum?....235
[SENSe:]PULSe:FREQuency:PPFRequency:SDEViation?....235
[SENSe:]PULSe:FREQuency:RERRor?....236
[SENSe:]PULSe:FREQuency:RERRor:AVERage?....236
[SENSe:]PULSe:FREQuency:RERRor:MAXimum?....236
[SENSe:]PULSe:FREQuency:RERRor:MINimum?....236
[SENSe:]PULSe:FREQuency:RERRor:SDEViation?....236

[SENSe:]PULSe:FREQuency:CRATe? <QueryRange>

Returns the chirp rate (per µs) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Chirp Rate" on page 19

[SENSe:]PULSe:FREQuency:CRATe:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:CRATe:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per µs) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:FREQuency:DEViation? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Frequency Deviation" on page 18

[SENSe:]PULSe:FREQuency:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the chirp rate (per µs) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:FREQuency:PERRor? <QueryRange>

Returns the peak frequency error for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Frequency Error (Peak)" on page 18

[SENSe:]PULSe:FREQuency:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak frequency error over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:FREQuency:POINt? <QueryRange>

Returns the frequency at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Frequency" on page 18

[SENSe:]PULSe:FREQuency:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:FREQuency:PPFRequency? <QueryRange>

Returns the Pulse-Pulse Frequency Difference for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse-Pulse Frequency Difference" on page 18

[SENSe:]PULSe:FREQuency:PPFRequency:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:PPFRequency:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Frequency Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:FREQuency:RERRor? <QueryRange>

Returns the Frequency Error (RMS) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Frequency Error (RMS)" on page 18

[SENSe:]PULSe:FREQuency:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:FREQuency:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the Frequency Error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Retrieving Phase Parameters

The following commands return the calculated pulse parameters.

For details on the individual parameters see chapter 3.1.4, "Phase Parameters", on page 19.

[SENSe:]PULSe:PHASe:DEViation? 237
[SENSe:]PULSe:PHASe:DEViation:AVERage? 237
[SENSe:]PULSe:PHASe:DEViation:MAXimum? 237
[SENSe:]PULSe:PHASe:DEViation:MINimum? 237
[SENSe:]PULSe:PHASe:DEViation:SDEViation? 237
[SENSe:]PULSe:PHASe:PERRor? 237
[SENSe:]PULSe:PHASe:PERRor:AVERage? 238
[SENSe:]PULSe:PHASe:PERRor:MAXimum? 238
[SENSe:]PULSe:PHASe:PERRor:MINimum? 238
[SENSe:]PULSe:PHASe:PERRor:SDEViation? 238
[SENSe:]PULSe:PHASe:POINt? 238
[SENSe:]PULSe:PHASe:POINt:AVERage? 238

[SENSe:]PULSe:PHASe:POINt:MAXimum?....238
[SENSe:]PULSe:PHASe:POINt:MINimum?....239
[SENSe:]PULSe:PHASe:POINt:SDEViation?....239
[SENSe:]PULSe:PHASe:PPPHase?....239
[SENSe:]PULSe:PHASe:PPPHase:AVERage?....239
[SENSe:]PULSe:PHASe:PPPHase:MAXimum?....239
[SENSe:]PULSe:PHASe:PPPHase:MINimum?....239
[SENSe:]PULSe:PHASe:PPPHase:SDEViation?....239
[SENSe:]PULSe:PHASe:RERRor?....240
[SENSe:]PULSe:PHASe:RERRor:AVERage?....240
[SENSe:]PULSe:PHASe:RERRor:MAXimum?....240
[SENSe:]PULSe:PHASe:RERRor:MINimum?....240
[SENSe:]PULSe:PHASe:RERRor:SDEViation?....240

[SENSe:]PULSe:PHASe:DEViation? <QueryRange>

Returns the phase deviation for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Phase Deviation" on page 20

[SENSe:]PULSe:PHASe:DEViation:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:DEViation:SDEViation? <QueryRange>

Returns the statistical value for the phase deviation over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:PHASe:PERRor? <QueryRange>

Returns the peak phase error for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Phase Error (Peak)" on page 19

[SENSe:]PULSe:PHASe:PERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PERRor:SDEViation? <QueryRange>

Returns the statistical value for the peak phase error over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:PHASe:POINt? <QueryRange>

Returns the phase at the measurement point for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Phase" on page 19

[SENSe:]PULSe:PHASe:POINt:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:MAXimum? <QueryRange>

[SENSe:]PULSe:PHASe:POINt:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:POINt:SDEViation? <QueryRange>

Returns the statistical value for the phase at the measurement point over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:PHASe:PPPHase? <QueryRange>

Returns the Pulse-Pulse Phase Difference for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Pulse-Pulse Phase Difference" on page 19

[SENSe:]PULSe:PHASe:PPPHase:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:PPPHase:SDEViation? <QueryRange>

Returns the statistical value for the Pulse-Pulse Phase Difference over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

[SENSe:]PULSe:PHASe:RERRor? <QueryRange>

Returns the phase error (RMS) for the specified pulse(s).

Query parameters:

<QueryRange> SELected | CURRent | ALL

SELected
Currently selected pulse

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Manual operation: See "Phase Error (RMS)" on page 19

[SENSe:]PULSe:PHASe:RERRor:AVERage? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MAXimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:MINimum? <QueryRange>
[SENSe:]PULSe:PHASe:RERRor:SDEViation? <QueryRange>

Returns the statistical value for the phase error (RMS) over the specified pulses.

Query parameters:

<QueryRange> CURRent | ALL

CURRent
Detected pulses in the current capture buffer

ALL
All detected pulses in the entire measurement.

Usage: Query only

Commands for Compatibility

The `[SENS:]TRAC:MEAS:...` commands are maintained for compatibility reasons only. For new remote control programs, use the corresponding `[SENS:]PULS:...` commands instead.

SENSe:TRACe:MEASurement:POWer:AVG? 241
SENSe:TRACe:MEASurement:POWer:MAX? 241
SENSe:TRACe:MEASurement:POWer:MIN? 241
SENSe:TRACe:MEASurement:POWer:PULSe:BASE? 241
SENSe:TRACe:MEASurement:POWer:PULSe:TOP? 241
SENSe:TRACe:MEASurement:PULSe:DCYCle? 241
SENSe:TRACe:MEASurement:PULSe:DURation? 241
SENSe:TRACe:MEASurement:PULSe:PERiod? 241
SENSe:TRACe:MEASurement:PULSe:SEParation? 242
SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation? 242

SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?....242
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?....242
SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MAXimum?....242

SENSe:TRACe:MEASurement:POWer:AVG?

Query the pulse average (Tx) power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MAX?

Query the pulse peak power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:MIN?

Query the pulse minimum power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:BASE?

Query the pulse base power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:POWer:PULSe:TOP?

Query the pulse top power values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DCYCle?

Query the duty cycle values in percent from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:DURation?

Query the pulse width values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:PERiod?

Query the pulse repetition interval values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:PULSe:SEParation?

Query the pulse separation (off time) values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:NEGative:DURation?

Query the fall time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:DURation?

Query the rise time values in seconds from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot?

Query the pulse rising overshoot power ratio values from the current capture.

Usage: Query only

SENSe:TRACe:MEASurement:TRANsition:POSitive:OVERshoot:MAXimum?
<QueryRange>

Query the pulse rising overshoot power ratio values from the current capture.

Parameters:
<QueryRange> SELected | CURRent | ALL

Usage: Query only

8.6.1.4 Exporting Trace Results to an ASCII File

Trace results can be exported to an ASCII file for further evaluation in other (external) applications.

FORMat[:DATA] 242
FORMat:DEXPort:DSEParator 243
FORMat:DEXPort:HEADer 243
FORMat:DEXPort:TRACes 244

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S VSE to the controlling computer.

Note that the command has no effect for data that you send to the R&S VSE. The R&S VSE automatically recognizes the data it receives, regardless of the format.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Decimal Separator" on page 81

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Usage: SCPI confirmed

Manual operation: See "Include Instrument Measurement Settings" on page 97

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 208).

Parameters:

<Selection>

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. Result Summary, marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Usage: SCPI confirmed

Manual operation: See "Export all Traces and all Table Results" on page 97

8.6.1.5 Exporting Table Results to an ASCII File

Table results can be exported to an ASCII file for further evaluation in other (external) applications.

Useful commands for exporting table results described elsewhere:

- `FORMat:DEXPort:DSEParator` on page 243
- chapter 8.4.10.6, "Configuring the Statistics and Parameter Tables", on page 174

Remote commands exclusive to exporting table results

MMEMory:STORe<n>:TABLe 244
MMEMory:STORe<n>:TABLe:LIMit 245

MMEMory:STORe<n>:TABLe <Columns>, <Filename>

This command stores the Table columns (all or selected) in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Parameters:

<FileName> String containing the path and name of the file.

Setting parameters:

<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

Usage: Setting only

Manual operation: See "Columns to Export" on page 81
See "Export Table to ASCII File" on page 81

MMEMory:STORe<n>:TABLe:LIMit <Columns>, <Filename>

This command stores the table columns (all or selected), along with limit check results in a file with ASCII format. The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the `FORMat:DEXPort:DSEParator` command.

Parameters:

<FileName> String containing the path and name of the file.

Setting parameters:

<Columns> SELected | ALL

SELected
Only the currently visible columns in the result display are exported.

ALL
All columns, including currently hidden ones, for the result display are exported.

Usage: Setting only

8.6.2 Retrieving Marker Results

The following commands are required to retrieve marker results.

Useful commands for retrieving marker results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 200
- `CALCulate<n>:MARKer<m>:X` on page 198

Remote commands exclusive to retrieving marker results:

CALCulate<n>:DELTamarker<m>:X:RELative?....246
CALCulate<n>:DELTamarker<m>:Y?....246
CALCulate<n>:MARKer<m>:Y?....246

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example: `CALC:DELT3:X:REL?`
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

Manual operation: See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

The unit depends on the application of the command.

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`INIT;*WAI`
Starts a sweep and waits for its end.
`CALC:DELT2 ON`
Switches on delta marker 2.
`CALC:DELT2:Y?`
Outputs measurement value of delta marker 2.

Usage: Query only

Manual operation: See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Return values:

<Result> Result at the marker position.

Example: `INIT:CONT OFF`
Switches to single measurement mode.
`CALC:MARK2 ON`
Switches marker 2.
`INIT;*WAI`
Starts a measurement and waits for the end.
`CALC:MARK2:Y?`
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 21
See "Marker 1 / Marker 2 / Marker 3 / Marker 4" on page 87
See "M1 Marker 1/ Delta 1/ Delta 2/.../Delta 16" on page 88

8.7 Programming Example: Pulse Measurement

This example demonstrates how to perform a pulse measurement in a remote environment.

Note that some of the used commands may not be necessary as they define default values, but are included to demonstrate their use.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Activate the pulse measurement application
INST:SEL 'PULSE'

//-----------Configuring the measurement ------------
//Set the center frequency
FREQ:CENT 1GHz

// Set the filter, bandwidth, and implicitly the sample rate
SENS:BWID:DEM:TYPE GAUSS
SENS:BWID:DEM 80MHZ
SENS:SRAT?

//Configure the expected pulse:
//width between 1ms and 1.5ms, off time at least 0.5ms
SENS:TRAC:MEAS:DEF:DUR:AUTO OFF
SENS:TRAC:MEAS:DEF:DUR:MIN 1ms
SENS:TRAC:MEAS:DEF:DUR:MAX 1.5ms
SENS:TRAC:MEAS:DEF:DUR:OFF 0.5ms

//Assume amplitude droop
SENS:TRAC:MEAS:DEF:PULS:ADR ON
```

```
//Assume Linear FM modulation
SENS:TRAC:MEAS:DEF:PULS:MOD LFM
//Pulse starts with rising edge
SENS:TRAC:MEAS:DEF:PULS:PER LH
//Determine freq offset and chirp rate for each pulse automatically
SENS:TRAC:MEAS:DEF:FREQ:OFFS:AUTO ON
SENS:TRAC:MEAS:DEF:FREQ:RATE:AUTO ON

//Input from RF input connector
INP:SEL RF
//Alternatively: Input from I/Q data file
//INP:SEL FIQ
//INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'

//Configure a power trigger at -20dBm (pulse level - 10dB default attenuation)
TRIG:SOUR RFP
TRIG:LEV:RFP -20dBm
//Avoid triggering on overshoot:
//level must remain below trigger level at least 0.5ms
TRIG:DTIM 0.5ms

//Configure the conditions for pulse detection:
//max. 10 pulses, min. -30dB power level, 2dB hysteresis
DET:LIM ON
DET:LIM:COUN 10
DET:REF ABS
DET:THR -30dB
DET:HYST 2dB

//Configure how and which levels are used for pulse detection:
//mean level for top, power values in dBm, consider droop
//ripple calculated in first 5% of pulse top
SENS:TRAC:MEAS:ALG MEAN
SENS:TRAC:MEAS:DEF:AMPL:UNIT DBM
SENS:TRAC:MEAS:DEF:COMP:ADR ON
SENS:TRAC:MEAS:DEF:RIPP 5

// meas levels at 15,50,85% power
//in dB: -1.41, -6.02, -26.02
SENS:TRAC:MEAS:DEF:TRAN:HREF -1.41
SENS:TRAC:MEAS:DEF:TRAN:REF  -6.02
SENS:TRAC:MEAS:DEF:TRAN:LREF -26.02

//boundary calculated in top 5% = 0.26dB
SENS:TRAC:MEAS:DEF:BOUN:TOP 0.26

//Configure which point is used to determine pulse characteristics:
//0.1ms from top center, window 1ms
SENS:TRAC:MEAS:DEF:PULS:INST:REF CENT
SENS:TRAC:MEAS:DEF:PULS:INST 0.1ms
```

```
SENS:TRAC:MEAS:DEF:PULS:INST:AWIN 1ms

//Configure the range used for estimation: 0.1ms from either edge
SENS:TRAC:MEAS:DEF:PULS:EST:REF EDGE
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:LEFT 0.1ms
SENS:TRAC:MEAS:DEF:PULS:EST:OFFS:RIGH 0.1ms

//Configure the range for which individual pulse results are displayed:
//300us starting from left edge of pulse top
SENS:TRAC:MEAS:DEF:RRAN:REF RISE
SENS:TRAC:MEAS:DEF:RRAN:ALIG LEFT
SENS:TRAC:MEAS:DEF:RRAN:LENG 300us

//Configure data acquisition for 10ms
SWE:TIME 10ms

//------------- Configuring the results ------------------------------
//Result displays:
//upper row: (1)MagCapt (2)Pulse results (3)Pulse statistics
//bottom row: (4)Pulse magnitude (5)Pulse power dist vs occurance
//(6)Pulse power spectrum
LAY:REPL '1',MCAP
LAY:REPL '2',PRES
LAY:ADD:WIND? '2',RIGH,PST
LAY:REPL '4',PMAG
LAY:REPL '5',PDIS
CALC5:DIST:POW POIN,OCC
LAY:REPL '6',PSP
CALC6:PSP:POW POIN

//Configure magnitude capture: automatic scaling
DISP:WIND1:TRAC:Y:SCAL:AUTO ON

//Configure parameters in pulse results table:
//Freq.: freq. at meas point, pulse-pulse difference, freq.dev., freq. err peak
CALC2:TABL:FREQ:POIN ON
CALC2:TABL:FREQ:PPFR ON
CALC2:TABL:FREQ:DEV ON
CALC2:TABL:FREQ:PERR ON

//Phase: phase deviation
CALC2:TABL:PHAS:DEV ON

//Power: average ON, droop, pulse-pulse difference, amplitude
CALC2:TABL:POW:ON ON
CALC2:TABL:POW:ADR ON
CALC2:TABL:POW:PPR ON
CALC2:TABL:POW:AMPL ON
//Limit check for average ON power: lower limit -10 dBm, upper: 1 dBm
CALC2:TABL:POW:ON:LIM:STAT ON
```

```
CALC2:TABL:POW:ON:LIM -10DBM,1DBM

//Timing: settling time, pulse width
CALC2:TABL:TIM:SETT ON
CALC2:TABL:TIM:PWID ON

//Configure pulse statistics table - same par. as results table
CALC3:TABL:FREQ:POIN ON
CALC3:TABL:FREQ:PPFR ON
CALC3:TABL:FREQ:DEV ON
CALC3:TABL:FREQ:PERR ON
CALC3:TABL:PHAS:DEV ON
CALC3:TABL:POW:ON ON
CALC3:TABL:POW:ADR ON
CALC3:TABL:POW:PPR ON
CALC3:TABL:POW:AMPL ON
CALC3:TABL:TIM:SETT ON
CALC3:TABL:TIM:PWID ON


//Configure pulse magnitude:
//scaling is 25 dBm above and below pulse mid level
DISP:WIND4:TRAC:Y:SCAL:AUTO OFF
DISP:WIND4:TRAC:Y:SCAL:RPOS 50
DISP:WIND4:TRAC:Y:SCAL:RVAL 0
DISP:WIND4:TRAC:Y:SCAL:PDIV 2


//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.


//---------------Retrieving Results-------------
//Select pulse for individual pulse results: pulse 1
SENS:TRAC:MEAS:DEF:PULS:SEL 1
//    Determine pulse numbers in entire meas
SENS:PULS:NUMB? ALL
//    Determine pulse numbers in current capture buffer
SENS:PULS:NUMB? CURR

//Retrieve parameter results from results table (pulse 1)
SENS:PULS:FREQ:POIN? SEL
SENS:PULS:FREQ:PPFR? SEL
SENS:PULS:FREQ:DEV? SEL
SENS:PULS:FREQ:PERR? SEL
SENS:PULS:PHAS:DEV? SEL
SENS:PULS:POW:ON? SEL
```

```
SENS:PULS:POW:ADR? SEL
SENS:PULS:POW:PPR? SEL
SENS:PULS:POW:AMPL? SEL
SENS:PULS:TIM:SETT? SEL
SENS:PULS:TIM:PWID? SEL

//Retrieve limit check result for average ON power in pulses in current meas
SENS:PULS:POW:ON:LIM? CURR

//Retrieve pulse statistics (aver., min., max) for all pulses in entire meas
SENS:PULS:FREQ:POIN:AVER? ALL
SENS:PULS:FREQ:POIN:MIN? ALL
SENS:PULS:FREQ:POIN:MAX? ALL

SENS:PULS:FREQ:PPFR:AVER? ALL
SENS:PULS:FREQ:PPFR:MIN? ALL
SENS:PULS:FREQ:PPFR:MAX? ALL

SENS:PULS:FREQ:DEV:AVER? ALL
SENS:PULS:FREQ:DEV:MIN? ALL
SENS:PULS:FREQ:DEV:MAX? ALL

SENS:PULS:FREQ:PERR:AVER? ALL
SENS:PULS:FREQ:PERR:MIN? ALL
SENS:PULS:FREQ:PERR:MAX? ALL

SENS:PULS:PHAS:DEV:AVER? ALL
SENS:PULS:PHAS:DEV:MIN? ALL
SENS:PULS:PHAS:DEV:MAX? ALL

SENS:PULS:POW:ON:AVER? ALL
SENS:PULS:POW:ON:MIN? ALL
SENS:PULS:POW:ON:MAX? ALL

SENS:PULS:POW:ADR:AVER? ALL
SENS:PULS:POW:ADR:MIN? ALL
SENS:PULS:POW:ADR:MAX? ALL

SENS:PULS:POW:PPR:AVER? ALL
SENS:PULS:POW:PPR:MIN? ALL
SENS:PULS:POW:PPR:MAX? ALL

SENS:PULS:POW:AMPL:AVER? ALL
SENS:PULS:POW:AMPL:MIN? ALL
SENS:PULS:POW:AMPL:MAX? ALL

SENS:PULS:TIM:SETT:AVER? ALL
SENS:PULS:TIM:SETT:MIN? ALL
SENS:PULS:TIM:SETT:MAX? ALL
```

```
SENS:PULS:TIM:PWID:AVER? ALL
SENS:PULS:TIM:PWID:MIN? ALL
SENS:PULS:TIM:PWID:MAX? ALL

//Retrieve trace data for pulse magnitude (pulse 1)
//TRAC4:DATA? TRACe1
//TRAC4:DATA:X? TRACe1

//Export entire result table (all params) to an ASCII file
//MMEM:STOR2:TABL ALL,'C:\R_S\Instr\user\AllResults.dat'

//Store I/Q data for result range to an iq-tar file
//MMEM:STOR:IQ:COMM 'I/Q data for result range'
//MMEM:STOR:IQ:RANG RRAN
//MMEM:STOR:IQ:STAT 1,'C:\R_S\Instr\user\RRTestdata.iq.tar'
```

A Annex: Reference

- Menu Reference....253
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A.1 Menu Reference

Most functions in the R&S VSE are available from the menus.

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- Pulse Measurements Menus....255

A.1.1 Common R&S VSE Menus

The following menus provide **basic functions for all applications**:

- File Menu....253
- Window Menu....254
- Help Menu....255

A.1.1.1 File Menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE User Manual.

Menu item	Corresponding icon in toolbar	Description
Save		Saves the current software configuration to a file
Recall		Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> New Measurement Channel	-	Inserts a new channel in the selected group

Menu item	Corresponding icon in toolbar	Description
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Selected Channel	-	Restores the default software configuration for an individual channel
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE software
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE software

A.1.1.2 Window Menu

The "Window" menu allows you to hide or show individual windows.

For a description of these functions see the "Controlling Instruments and Capturing Data" chapter in the R&S VSE User Manual.

Menu item	Corresponding icon in toolbar	Description
Player...	-	Displays the "Player" tool window to recall I/Q data recordings
Instrument Setup...	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup...	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >		Inserts a new result display window for the selected measurement channel
Channel Infos >	-	Displays the channel bar with global channel information for the selected meausrement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated
Configure Selected Result Window	-	Displays the "Window Configuration" dialog box to configure result-specific settings

A.1.1.3 Help Menu

The "Help" menu provides access to help, support and licensing functions.

For a description of these functions see the "Basic Operations" and "General Software Settings" chapters in the R&S VSE User Manual.

Menu item	Corresponding icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Attempts to create an email with the default mail program (if available) to the Rohde & Schwarz support address for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.1.2 Pulse Measurements Menus

The following menus are only available if an Pulse measurement channel is selected.

- Input & Output Menu....256
- Meas Setup Menu....256
- Trace Menu....256
- Marker Menu....257
- Limits Menu....257

A.1.2.1 Input & Output Menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table 1-1: "Input" menu items for Pulse Measurements

Menu item	Description
Amplitude	chapter 5.4.2, "Amplitude Settings", on page 53
Scale	chapter 6.1.5, "Y-Scaling", on page 83
Frequency	chapter 5.4.1, "Frequency Settings", on page 52
Trigger	chapter 5.5, "Trigger Settings", on page 56
Input Source	chapter 5.3.1.1, "Radio Frequency Input", on page 47
Output	chapter 5.3.2, "Output Settings", on page 50

A.1.2.2 Meas Setup Menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table 1-2: "Meas Setup" menu items for Pulse Measurements

Menu item	Description
Signal Description	chapter 5.2, "Signal Description", on page 45
Input/Frontend	chapter 5.3, "Input and Output Settings", on page 47
Data Acquisition	chapter 5.6, "Data Acquisition", on page 61
Pulse Detection	chapter 5.7, "Pulse Detection", on page 62
Pulse Meas	chapter 5.8, "Pulse Measurement Settings", on page 64
Result	chapter 6.1, "Result Configuration", on page 71
Selected Pulse	chapter 6.1.1, "Pulse Selection", on page 71
Overview	chapter 5.1, "Configuration Overview", on page 43

A.1.2.3 Trace Menu

The "Trace" menu provides access to trace-specific functions.

See chapter 6.3, "Trace Configuration", on page 92

This menu is application-specific.

Table 1-3: "Trace" menu items for Pulse Measurements

Menu item	Description
Trace <x>	Selects the corresponding trace for configuration. The currently selected trace is highlighted blue
Copy Trace	Copies trace data to another trace
Trace ...	Opens the "Traces" configuration dialog box

A.1.2.4 Marker Menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table 1-4: "Marker" menu items for Pulse Measurements

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		"Select Marker" on page 90
Marker Type		"Marker Type" on page 89
Marker to Trace	-	"Assigning the Marker to a Trace" on page 89
All Markers Off		"All Markers Off" on page 90
Marker...		chapter 6.2, "Markers", on page 86

A.1.2.5 Limits Menu

The "Limits" menu does not contain any functions for Pulse measurements.

A.2 Reference of Toolbar Functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.
   A context menu with a list of all available toolbars is displayed.
2. Select the toolbar you want to hide or display.

A checkmark indicates that the toolbar is currently displayed.

The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

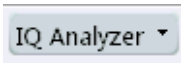
Table 1-5: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel

"Control" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-6: Functions in the "Control" toolbar

Icon	Description
	Selects the currently active channel
	Capture: performs the selected measurement
	Pause: temporarily stops the current measurement
	Continuous: toggles to continuous measurement mode for next capture
	Single: toggles to single measurement mode for next capture

Icon	Description
	Record: performs the selected measurement and records the captured data and results
	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-7: Functions in the "Help" toolbar

Icon	Description
	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

For a description of these functions see the R&S VSE Base Software User Manual.

Table 1-8: Functions in the "Zoom" toolbar

Icon	Description
	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
	Zoom off: displays the diagram in its original size

Table 1-9: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Select marker
	Marker type "normal"
	Marker type "delta"

Icon	Description
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table 1-10: Functions in the "AutoSet" toolbar

Icon	Description
	Auto level
	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)

Icon	Description
AUTO ALL	Auto all
	Configure auto settings

A.3 Reference: ASCII File Export Format

Trace data can be exported to a file in ASCII format for further evaluation in other applications

The file consists of the header containing important scaling parameters and a data section containing the trace data.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS-Excel. Different language versions of evaluation programs may require a different handling of the decimal point. Thus you can define the decimal separator to be used (decimal point or comma, see "Decimal Separator" on page 81).

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the two lines containing the measured parameter names and units, followed by the measured data in multiple columns (depending on measurement) which are also separated by a semicolon.

Table 1-11: ASCII file format for table export

File contents	Description
Header data	
Type;R&S VSE;	Instrument model
Version;5.00;	Firmware version
Date;01.Oct 2006;	Date of data set storage
Mode;PULSE;	Application
Center Freq;55000;Hz	Center frequency
Freq Offset;0;Hz	Frequency offset
Meas BW;10000000,Hz	Measurement Bandwidth
Filter Type;GAUS;	Measurement filter type can be Gaussian (GAUS) or flat (FLAT)
Ref Level;-30;dBm	Reference level
Level Offset;0;dB	Level offset
Rf Att;20;dB	Input attenuation
El Att;2.0;dB	Electrical attenuation
SWT;0.005;s	Sweep time (measurement time)

File contents	Description
Sweep Count;20;	Number of sweeps set
Preamplifier;OFF	Preamplifier status
Top Pos.;CENT;	Top (100%) level position can be Edge (EDGE) or Center (CENT)
Top Alg.;MEDI	Top level measurement algorithm can be Median (MEDI) or Mean (MEAN)
Ripple Portion;50;%	Portion of pulse top where ripple is measured
High Level;90;%V	High (distal) threshold level
Mid Level;50;%V	Mid (mesial) threshold level
Low Level;10;%V	Low (proximal) threshold level
Boundary;3;%V	The (top +/-) boundary level
Point Ref;CENT;	Measurement point reference can be Rise (RISE), Center (CENT) or Fall (FALL)
Point Offset;0;s	Measurement point offset
Range Ref;CENT;	Measurement range reference can be Center (CENT) or Edge (EDGE)
Range Length;75;%	Measurement range length (only valid for “Range Ref:;CENT”)
Range Offset Rise;0;s	Measurement range offset from rising edge (only valid for “Range Ref:;EDGE”)
Range Offset Fall;0;s	Measurement range offset from falling edge (only valid for “Range Ref:;EDGE”)
Data section	
Values; 1001;	Number of rows of measured values in the table
ID:;Pulse No.:;Rise Time:;…	Pulse parameter names
Unit;;s;…	Unit of pulse parameters
1;1;10.0e-9;… 2;2;10.1e-9;… 1;3;9.9e-9;… …;…;…;…	Measured values: <ID>, <Pulse No.>, <Param 1>, … , <Param N>

A.4 Effects of Large Gauss Filters

As an alternative to the nearly rectangular "flat" measurement filters, the R&S VSE also provides Gaussian filters. Gaussian filters have an optimized settling behavior, which avoids overshoot distortions in time domain data.

However, for Gaussian filters whose -3dB bandwidth is large compared to the maximum I/Q bandwidth, the ideal Gaussian filter shape would exceed the maximum I/Q bandwidth at its outer edges. Thus, the actual filter only follows the ideal Gaussian filter

shape in the inner range of the set I/Q bandwidth. At a certain frequency offset it must deviate from the ideal Gauss filter and drop off faster.

Gaussian filters with large -3dB bandwidths (<10 MHz)

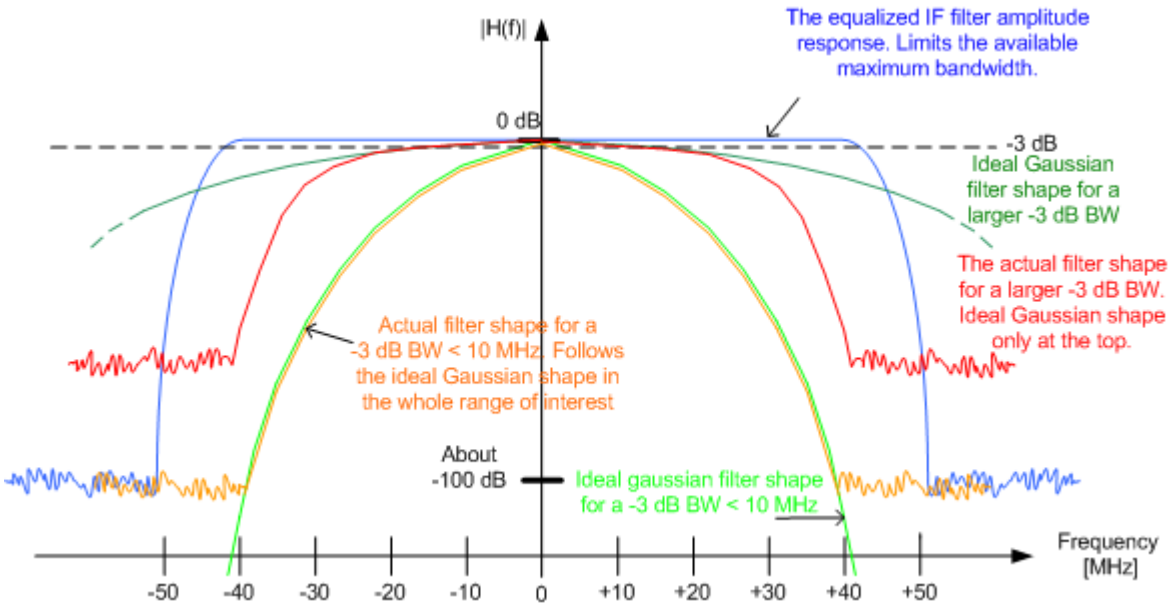

|H(f)|
The equalized IF filter amplitude response. Limits the available maximum bandwidth.
0 dB
-3 dB
Ideal Gaussian filter shape for a larger -3 dB BW
The actual filter shape for a larger -3 dB BW. Ideal Gaussian shape only at the top.
Actual filter shape for a -3 dB BW < 10 MHz. Follows the ideal Gaussian shape in the whole range of interest
About -100 dB
Ideal gaussian filter shape for a -3 dB BW < 10 MHz
Frequency [MHz]
-50
-40
-30
-20
-10
0
+10
+20
+30
+40
+50

Table 1-12: Gauss filters with large -3 dB bandwidths

-3 dB BW	Max. freq. with Gaussian shape	Attenuation at max. freq.	Attenuation at I/Q range edge (±40 MHz)
40 MHz	+/-24 MHz	4 dB	> 60 dB
28 MHz	+/-22 MHz	7 dB	> 65 dB
18 MHz	+/-28 MHz	29 dB	> 100 dB
10 MHz	+/-25 MHz	75 dB	> 100 dB

List of Remote Commands (Pulse)

[SENSe:][STATistic<n>:]TYPE 196
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion] 195
[SENSe:][WINDow<n>:]DETector<t>[:FUNCtion]:AUTO 196
[SENSe:]AVERage<n>:COUNt 195
[SENSe:]AVERage<n>[:STATe<t>] 195
[SENSe:]BANDwidth:DEMod 127
[SENSe:]BANDwidth|BWIDth:DEMod:TYPE 127
[SENSe:]BWIDth:DEMod 127
[SENSe:]DETect:HYSTeresis 129
[SENSe:]DETect:LIMit 128
[SENSe:]DETect:LIMit:COUNt 128
[SENSe:]DETect:REFerence 129
[SENSe:]DETect:THReshold 129
[SENSe:]FREQuency:CENTer 114
[SENSe:]FREQuency:CENTer:STEP 115
[SENSe:]FREQuency:CENTer:STEP:AUTO 115
[SENSe:]FREQuency:OFFSet 115
[SENSe:]PULSe:FREQuency:CRATe:AVERage? 233
[SENSe:]PULSe:FREQuency:CRATe:MAXimum? 233
[SENSe:]PULSe:FREQuency:CRATe:MINimum? 233
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